AUG 4 1933

# Heating · Piping and Air Conditioning

***Industrial Recovery Act Codes***

**Indicate Need For Modernization**

**Prefabricating Process Piping**

**Aircraft Heating and Ventilating**

**Flexibility in Air Conditioning**

**Journal Section of the A.S.H.V.E.**

***August 1933***

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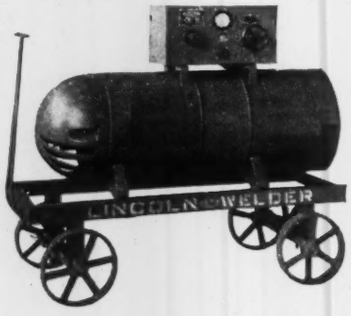


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# Heating · Piping and Air Conditioning

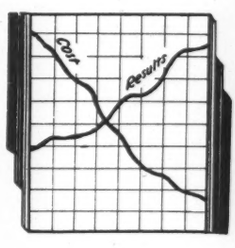
## THE EDITOR'S PAGE

MODERNIZATION being good engineering, we've devoted no little attention to it in past months by means of articles giving authoritative data on what plants and buildings have actually accomplished by modernizing their heating, piping, and air conditioning facilities; indicating what others may do in decreasing costs, increasing results. Most readers will recall last January's "Modernization Number" — built entirely around the modernization theme.

A few pages along we point out the effect the new set-up in industry apparently will have in stressing the importance of modernization, and suggest that a check-up of existing heating, piping, and air conditioning systems would be a smart thing to do, in view of the widespread modernization activity which seems inevitable in the future.

We also point out what a premium has been placed on good engineering and modern equipment in textile mills by the adoption of the textile industry's code, the first to be drafted and put into operation under the National Industrial Recovery Act. This is a practical example of what other industries must expect to do if they are to operate and produce profitably in the shorter working hours and with the higher wages imposed by the new codes.

IN ADDITION, for those readers who are interested in the preparation and submission of codes for their own industries, we have obtained authoritative word from Washington as to how to proceed. It will be noted, following the above material, that members of the various branches of the construction industry should formulate their own codes through their national associations and the latter, in turn, will submit them, as part of a general construction industry code, through the Construction League of the United States, with headquarters at 1741 New York Avenue, Washington, D. C.




BY no means is the importance of modernization confined to industry; it's good engineering in other buildings too. Writing in the "Executives Service Bulletin" of the *Metropolitan Life Insurance Company* (June, 1933) J. C. Knapp has pointed out the advantages of progressive building modernization, concludes that if it becomes generally adopted we will have made an approach to national stabilization of building operations.

Speaking of building modernization, the comparatively youthful Tribune Tower (the *Chicago Tribune's* headquarters) is to be air conditioned completely. The announcement was made in a lead editorial in the *Trib* last month, indicating the public interest in air conditioning. As further evidence of public interest in the subject, the *Tribune* will report in its columns from time to time the advances made toward the solution of the problem. So important did the editors of *Time*, the weekly newsmagazine, consider the *Tribune's* plans, they gave the story of the announcement the lead-off position in their "Press" section.

BEFORE we forget it, don't fail to read E. F. Sisson's article on page 397 if you are concerned with process piping. This article has a two-fold purpose: first, to describe how Newport Industries, Inc., are saving time and money and getting an especially workmanlike job by using prefabricated process piping instead of the measure, cut, piece-by-piece method. Second, it is hoped that others who have had experience with process piping will be stimulated by Sisson's article, tell us—and our readers—what they've done along these lines. Mr. Sisson (who dropped in to see us when he was in Chicago last week) says that we caught him unawares; never thought of writing an article and didn't realize he had 'til he finished it. So, if you've had experience along these lines, tell us about it and perhaps we can plan an article with you, catch you unawares.

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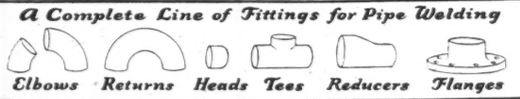

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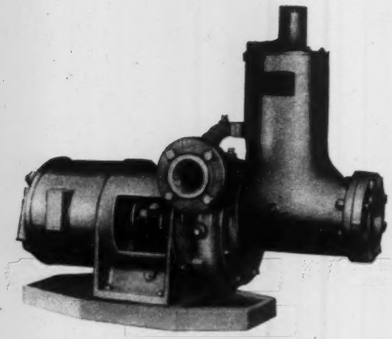

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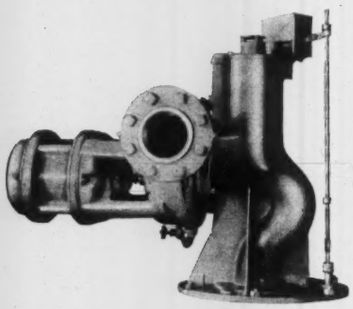

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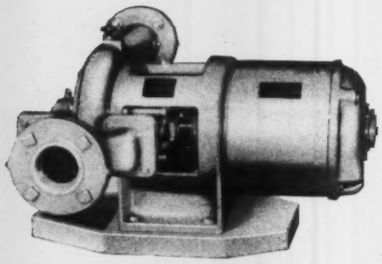

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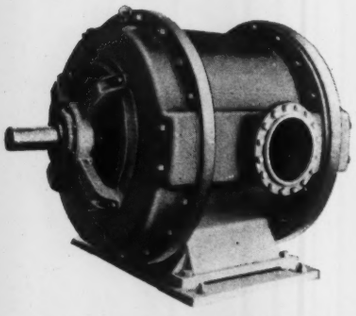

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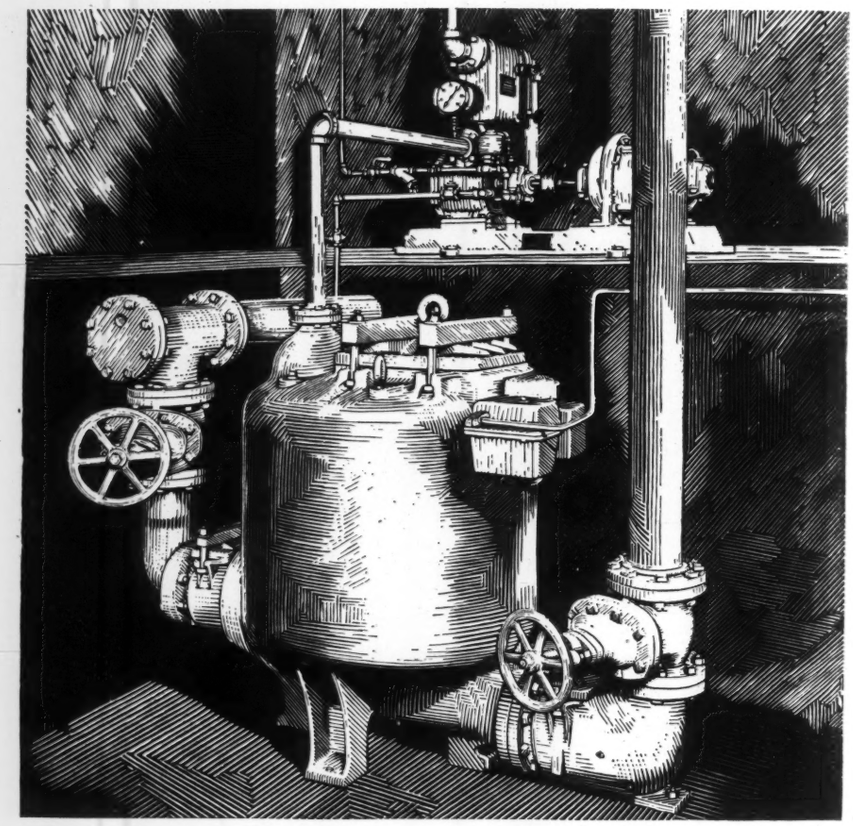

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Vol. 5, No. 8 · August, 1933

# *National Industrial Recovery Act Codes*
# Indicate Need for Modernization

THAT even a greater premium than heretofore will be put on the modernization of existing plant facilities and the utilization of up-to-the-minute methods and technique is the conclusion reached after reading drafts of several of the industrial-recovery-act codes. With various limitations on working hours for men and machinery, it seems logical that plant operation during such hours must be all the more efficient, must be thoroughly up-to-date, if profits are to be made. Standardization in hours of operation, wages, machinery per employe, etc., cause other factors in production to assume more importance. Ultimately, profits will be regulated to a greater extent by the efficiency of an organization.

It has been a natural impulse in past months to seek economy by limiting expenditures, but when the modernization of old equipment or systems or the purchase of new will repay the initial investment many times over in decreased operating costs and improved efficiency, neglect to make the required investment is wasteful. Records are available of plants which have modernized to advantage which show conclusively that well-planned modernization is good engineering. These experiences of others indicate the need for a thorough check-up in every plant, as in many a plant old, worn-out, or obsolete equipment—or methods—are causing a tremendous dollar loss every day.

## Many Opportunities for Modernization

Industry's heating, piping and air conditioning services present fruitful modernizing opportunities to secure the increased efficiency the new deal in industry apparently will demand. Far from being a detriment, the depression years seem to have given added impetus to the development of improved equipment and better technique in heating, piping, and air conditioning. New ideas and methods, have made obsolete systems installed but a few years ago; modern practice makes them too expensive to operate longer.

Consider piping. By studying their processing, many plants have found it possible to pipe process materials with consequent economies in conveying and handling costs. Only within the last few years have industrial liquids been piped on a large scale. . . . New piping materials, undreamed of a decade ago, and improved old ones, have been developed to meet the almost limitless conditions found in industry. . . . New methods of installation, welding, improved fabrication methods, more accurate design procedures—all must be considered if plant efficiency is to be maintained, and will be employed by those plants which see the possibilities in modernization of industrial piping, plan for it carefully.

Heating, a major service in every plant, should be scrutinized when increased efficiency is the aim. New types of radiation and heat-transfer surfaces, unit heaters, improved applications of temperature control, new types of boilers and furnaces, new fuels, etc., have changed the picture. In many a plant advantage is not being taken of utilizing sources of waste heat, using exhaust steam for space heating, etc. Frequently, some change in plant operating conditions has taken place which puts different requirements on the heating system and indicates its modernization.

Air conditioning must not be overlooked. It has been stated that the $30,000,000 worth of air conditioning now installed in over two hundred industries is saving

the plants that have it $15,000,000 annually. The same authority says that only one-fourth the plants that could employ air conditioning as an effective production aid have it. Air conditioning has proved its worth to industry, is considered indispensable to many a process. Further applications in those industries which now find conditioned air profitable, new applications in others, are indicated.

### Should Be Considered by Every Plant Executive

No engineer responsible for the efficient operation of an industrial plant is going to be "sold" on the benefits of modernization just because it sounds good. At the same time, the results in decreased costs and improved efficiency that plants which have modernized have obtained can't be disregarded. With changing conditions in industry apparently putting greater importance on modern, efficient operation, industry must check its production services—particularly those in which developments have been many—with an eye toward their modernization. Among these are heating, piping, and air conditioning.

### "Necessary Installation of New Equipment Should Go On," Says Johnson

WASHINGTON, D. C., July 14.—Fifty-five editors and publishers representing members of The Associated Business Papers, Inc., met here to consider various phases of national industrial recovery activities. In addition to conferences with a number of other administration officials, they were addressed by General Hugh S. Johnson.

In reply to a question asking if there was anything in the statement that the policy of NIRA might discourage modernization in plants, General Johnson said: "No, I think that the necessary installation of new equipment should go on. If you stopped inventiveness and progress, that would be very stupid. I do think for a short period it would be wise not to emphasize the installation of machinery that would tend to further reduce the field of employment. It is not our purpose here to stop economic progress."

# Modernized Humidification

## *Will Aid Textile Mills*

## in Maintaining Profits

*By* **George Fuller***

FIRST of the National Industrial Recovery Act codes to be accepted by the Administration, that of the cotton-textile industry has been a center of interest to all industrialists and to the public. Its style and content have been studied in connection with the drafting of codes for other industries; the hearings clarified a number of questions which have arisen since the Recovery Act was passed. Finally, the effect operation under the code will have in the textile industry should be indicative of similar effects which will be felt in other types of industries—under other codes, of course, but the purpose of which will be in general the same.

It is felt therefore that this discussion will prove of value not only to those concerned with the textile industry, but will also be of interest to engineers concerned with the efficient operation of all types of plants, which national regulation will apparently make of increased importance.

Under national regulation in the cotton-textile industry profit margins will become less and perhaps vanish for those concerns which are not well operated and do not have reasonably good equipment. Labor costs will advance from approximately 35 per cent to as much as 75 per cent on the hour basis, without considering any other factors. Necessarily, overhead per machine will increase and at higher cost levels the savings through improvements will be greater than previously. This applies in most departments.

It appears very probable that little change will be permitted in the number of machines per operative unless it can be demonstrated that the actual labor involved is not increased. This means that increase in production must be obtained by exactness in control, *i. e.*, more good yarn per spindle and more good cloth per loom. The strength of the yarn must be increased to permit better spinning and better weaving and the losses through seconds must be decreased. Percentages of production must be increased. The figures following show quite clearly what effect a small saving per machine will do to the total costs.

Regulation will reduce the total production per employe unless more machinery can be handled. It also

*Cox & Fuller, Consulting Textile Specialists, New York City.

is likely to force the employment of many less skilled workers. As a result manufacturers will give more attention to comparisons of production, to losses from defective goods, and to other such matters, than in the past. There can be only one conclusion from such investigations; namely, that in many instances production has been less than it should have been and losses too large, and that much of the trouble has been due to lack of control. Often the important savings possible can well be the difference between reasonable and entire lack of profits.

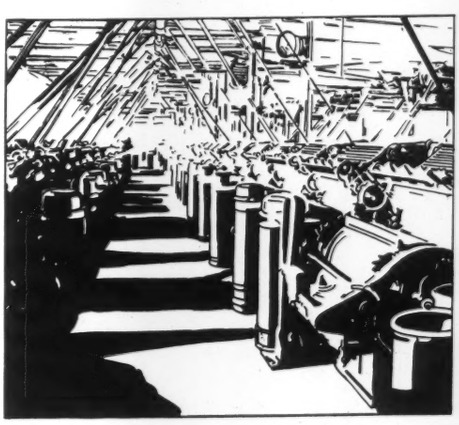
### Value of Humidity Control Established

The necessity for and the value of humidification in increasing production, quality, and profit in textile mills has been demonstrated repeatedly over a period of years. Still, there are many plants insufficiently humidified to permit reasonable control and many where satisfactory control is out of the question. It may appear impossible, but it is a fact, that in one concern investigated the percentage of weave-room production was about 44 per cent of theoretical. Various conditions were responsible but practical lack of any satisfactory humidifying apparatus was one of the main causes. In another plant where exceptionally good mechanical conditions existed the percentage of production was less than 65 and was due entirely to room variation in humidity in spinning and weaving, which condition affected general operation and even rates of wages. The normal percentage of production should have been at least 85 and later was increased to above this level. Modernization of such plants with humidity control equipment is of considerable importance.

### What Control Means

Not often are comparisons made to indicate what proper humidification can mean to the manufacturer of cotton goods. The following cases illustrate different phases of the subject and have occurred in actual plant operation.

In one large organization operating 1,000 looms upon a certain type of colored fabric, it so happened that Saturday operation was discontinued. The humidity was cut off until shortly before starting time on Monday morning. The total production averaged about 5200 pieces per week of 60 yards and of this amount 550 pieces (10.6 per cent of the total) were of different shade than normal. The amount of shaded goods was 33,000 yards, of which about 50 per cent was sold at 1c per yard less, or $165, and the remainder was sold to selected buyers at the normal price even though the shade varied somewhat.



In addition, the production on Monday averaged 3.5 yards per loom less than for other days or a total of 3500 less for the 1000 looms. This was 694 lb with a cost of 8.73c per lb or $60.59 per week. The actual seconds made outside of the shaded goods was about 3 per cent greater, which at 1c per yard less amounted to $16.95 per week. The extra cost of inspection, for separation and classifying was $52.00 per week. The total loss was $294.54 per week or about $15,316 per year.

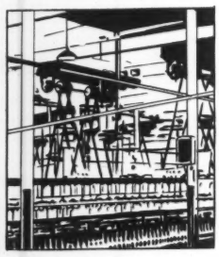
The real cause of the trouble was lack of moisture in the yarns due to week-end standing and drying out; the different shades were due to the rubbing of colored warp on the white filling, the effect varying, depending on the moisture content in the yarn. It is true that crocking occurred at a normal moisture standard, but the important consideration was that the result was different than normal and clearly apparent to any buyer. The whole situation was corrected by starting humidification 6 hours before weaving commenced.

Another case is that of a large organization with 1500 looms producing finished goods. On the type of fabric made the production was about 95 lb per loom per week, or 142,500 lb. As a result of tests on the cloth as sold it was found that the moisture content varied from 3.8 to 5.5 per cent but that the average was 4.4 per cent. This was 2.1 per cent less than the standard of 6.5 per cent for cloth. It explained why the seller regularly had to quote lower prices than competitors to secure the business, as buyers compared the poundage prices and the seller invariably gave the dried-out or cloth-room weights as a basis. A 2.1 per cent loss represented 2992.5 lb of cloth, which at 40c per lb was $1,197 per week or $62,244 per year. This was several times the cost of apparatus sufficient to rectify the condition.

In another plant the moisture content ran consistently about 5 per cent, instead of the 7 per cent which is normal. The yarn made was 30/1, which is presumed to average 64 lb in tensile strength per skein. There is a loss in strength of about 6 per cent for each 1 per cent in moisture content or a difference in this yarn of 12 per cent, or 56.3 lb. This corresponded approximately with plant comparisons. Tests made showed that there was a difference of about 3 per cent in percentage of production, that is, from 167.28 yards to 173.4 yards per loom per week. On 1000 looms this was 6120 yards per week or 318,240 yards per year. It represented a difference in overhead in weaving (the productive rate was not changed) of $0.0009 per yd or about $286 per year. The interesting fact was that when humidity conditions were made normal it was possible to increase machines per operative about 25 per cent, which represented $0.0053 per yd or $0.9169 per loom per week, $47.65 per loom per year and a total for 1000 looms of $4,765, which (with the $286 saving in overhead) amounted to $5,051. This certainly would represent more than 50 per cent of the cost of equipment to produce the controlled operating conditions, many times the amount needed to change to normal.

### Modern Equipment, Technique Important

Many advances have been made in recent years in the equipment for mill humidification and in the technique of installing and operating it. If best results are to be secured, it behooves the textile mill—and any plant processing hygroscopic materials—to take cognizance of modern methods of humidity control, employ them to advantage.



Many plants have found it profitable to install additional equipment and to make operation almost entirely automatic. In such cases the old equipment has not necessarily been discarded but has been made more automatic, new apparatus being added according to requirements. Many concerns have installed additional humidification at points just before the materials are put up for shipment, to prevent goods being dried out when woven and unfinished, or dried out by heat when finished. A check-up of such conditions should be made.

One objectionable feature found in many older installations is the irregularity in conditions in the same department, often due to placing the apparatus without giving consideration to the openings for traffic and particularly for ventilation, and not providing for the effect of heat on certain sides or portions of the buildings. In many plants conditions vary widely, depending upon how near to or how far away from the apparatus comparisons are made. Warp ends have been observed snapping back like small rubber bands at one side of a room where the sun's heat was greatest and with many looms idle, while ideal conditions existed at the opposite side with practically no yarns breaking, with all of the humidifiers running full in both sections and the difference in conditions due to temperature and air circulation.

In cases of this kind, plant modernization with humidity-control equipment should be carefully considered if profits are to be made under the new deal.

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# Construction Industry Codes to be Handled Through *Construction League of U. S.*

THE various branches of the building industry will submit their codes to the administrator of the National Industrial Recovery Act through the *Construction League of the United States,* whose address is 1741 New York Avenue, Washington, D. C. This is according to direct word received by Engineering Publications, Inc., publishers of HEATING, PIPING AND AIR CONDITIONING, from an authoritative source in Washington, and is aimed to eliminate the time and labor involved in separate hearings on codes for each individual branch of the building industry.

As noted before in this issue, a number of business paper publishers and editors were at Washington not long ago, met and talked with General Johnson and were asked to present to their respective industries the real facts, as they would be released from his offce, on developments under the Recovery Act. The following, abstracted from a letter to our publication, will be of interest to those in our field whose associations are now drafting and preparing to submit codes for their industry:

"There is being organized in the *Construction League of the United States* a code committee which is formulating a code for the industry. Such a code will probably contain general clauses in the spirit of the Recovery Act to which all branches of the industry can subscribe and also the individual codes of each branch as produced by the national organizations.

"Such organizations as the *Heating and Piping Contractors National Association* and others would be included under the code submitted by the Construction League.

"Producers of materials, who are not in the business of installing the materials, are, at the present time, expected to submit separate codes or to combine in groups which will subscribe to a single code. It is clearly advisable to have associations in similar enterprises combine as far as possible and submit codes prepared by national associations truly representative of the industries throughout the country. If local branches of similar industries each submit codes, it will be a never-ending labor to correlate them, hold the necessary hearings, and carry out the required procedure for adoption.

"The National Industrial Recovery Act permits industry to organize itself and agree upon its code of fair practice under the specifications of the act. In order that self-government be assured in the industry in adhering to its accepted code, it is clear that it ought to be organized nationally and co-ordinated, where possible, with similar or dependent activities.

"Those industries which naturally fall under the head of branches of the construction industry, other than producers of material who do not install the materials on the work, can aid materially in the preparation of a code for the construction industry, as a whole, by cooperating through their national associations with the activities of the committee."

# *Newport Industries, Inc. Save Time and Money by*

# Prefabrication of Process Piping

*By* E. F. Sisson*

***SAVINGS** in time and money and an especially workmanlike job are among the advantages which have been secured by Newport Industries, Inc., by the prefabrication of aluminum process piping. The author describes the method used and the results secured in this article.....The piping is used in connection with the production of steam-distilled turpentine, pine oil, and solvent-extracted rosin from yellow-pine stumps, and further conversion of the rosin into pale grades, involving a number of cycle operations.*

BY prefabricating aluminum process piping (rather than installing it by the measure, cut, piece-by-piece method) Newport Industries, Inc., are obtaining sizeable savings. Our experience is outlined here, as it is felt others who have prefabricated process piping will find it of interest and will want to contribute similar information on what has been accomplished in other plants.

### Process Involves Considerable Piping

The production of steam-distilled turpentine, pine oil and solvent extracted rosin from yellow pine stumps and the further conversion of rosin into pale grades involves a number of cycle operations, which means the transfer from one vessel to another through a series, of either the extracting solvent or solutions of the material being treated. The retorts and towers — twenty-odd feet in length—stand vertically in banks of from twelve to twenty. The materials transferred must in most cases pass from the top of one to the bottom of the next one in the series, which may or may not be the one adjacent. The piping is somewhat further complicated by the fact that in some operations three distinct materials must pass through the same vessel in consecutive order without extensive dilution of one material by that immediately following.

To accomplish this operation requirement, separate piping must be provided, the bulk of which is aluminum because of a certain degree of iron sensitiveness in the product.

Recently, we found it necessary to increase the converting capacity of one of the plants. For several reasons it seemed advisable to replace existing extractors, and quantities handled called for the addition of other major pieces of equipment. This need provided a chance to simplify the process piping, which, due to operation changes and a previous enlargement, had become both inefficient from a labor standpoint and likely to cause errors in operation.

Acquaintance with automatic-sprinkler layout procedure had indicated the material savings to be made by the use of prefabricated piping, *i. e.,* cut to length with flanges where required "made on." The accuracy required in placing sprinkler heads, however, is of a much lesser order than repeated connections to specific outlet nozzles on pressure vessels. The superintendent in charge of installation agreed to place the vessels on the supporting steel so that their nozzles would be in exact location within the limits of their accuracy of position on the vessels. The vessel fabricators promised exact location of the nozzles, limited of course to slight discrepancies due to stress relief during annealing of the vessels.

### Ten Different Pieces Required

Our first sketches of the various assembly pipes called for twenty-six different pieces. Further revisions and changes finally reduced this number to ten, part right-hand and part left-hand. Proper choosing of breaking points between pieces was responsible for the greater part of this reduction. In this particular battery of towers extra operating space had been allowed between each group of six arranged in two rows. We felt that since this was our first effort at prefabrication that some provision should be made at intervals for accumulated error. With this in mind we provided spools flanged at only one end which could be made up after the erection of all other piping and the measurement of the distance between adjacent flanges. As the installation worked out it would have been quite safe to make up the entire pipe

*Newport Industries, Inc., Pensacola, Florida.

assembly because the discrepancy was less than a gasket thickness. It should be borne in mind that each end of each section of pipe throughout the system had flanges welded inside and out to the pipe. Screwed aluminum flanged connections with cast flanges had previously been proven unsatisfactory from the standpoint of leakage and it was essential that the system permit of quick dismantling and re-assembly at a number of points. The piping drawing here shown indicates a 7¾-in. radius on 3-in. pipe bends, which was later reduced to the standard 4½-in. radius of long-turn welding fittings.

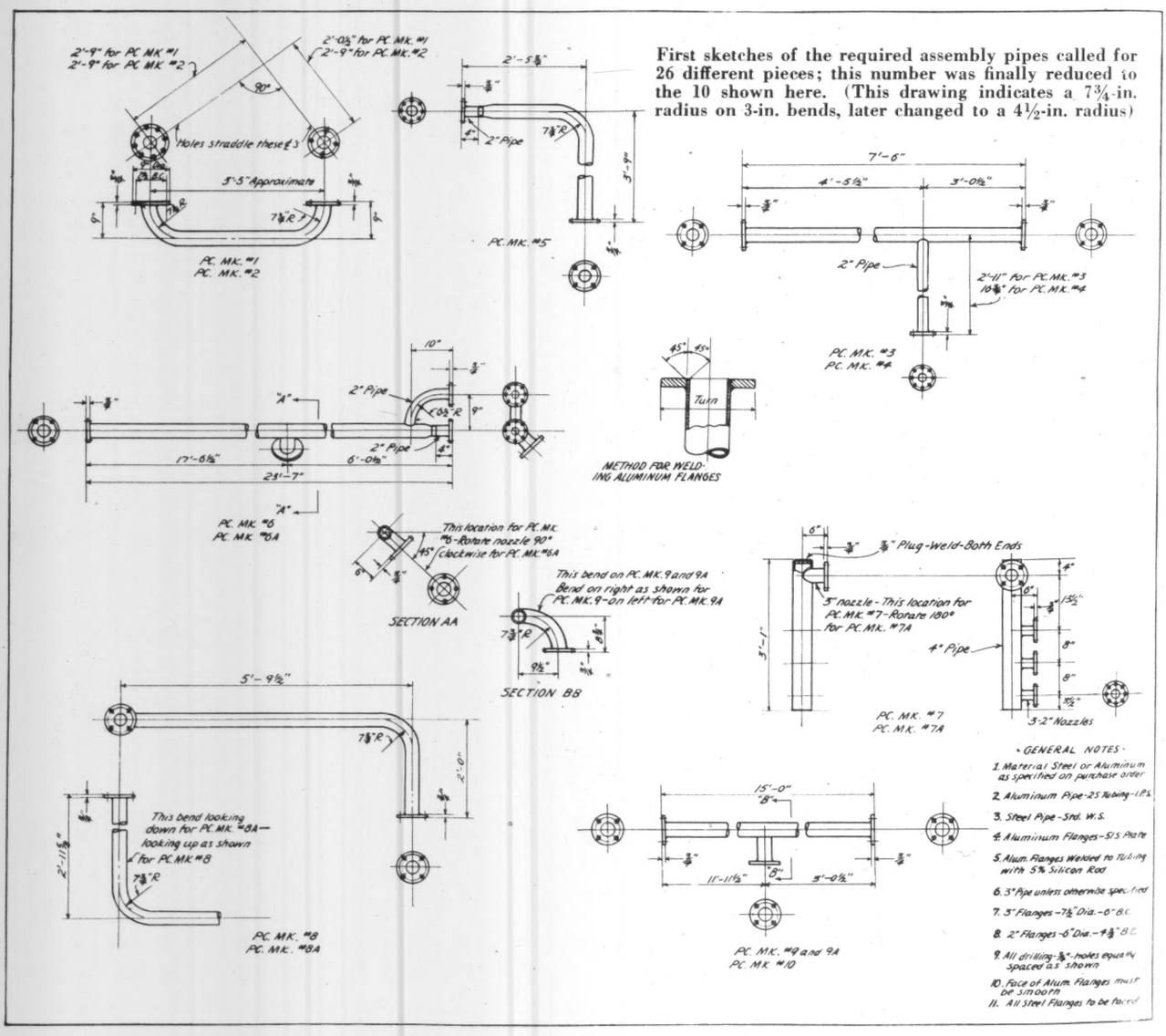
### Savings Made by Prefabrication

On the purchase of 107 pieces (41 of which were steel and the balance aluminum) the following advantages were obtained:

1. Cost from proposals, for material only to produce these units was $2,485.00. Estimated labor cost was $550.00. Total cost would therefore have been $3,035.00. This material was secured from a piping fabricator delivered at the plant for $2,580.00, an actual cash saving of $455.00.
2. Our regular piping crew and welders were free to handle other parts of the installation not readily adapted to prefabrication and regular maintenance work.
3. A saving in time, conservatively estimated, on the completion of the installation of not less than ten days.
4. An especially workmanlike installation.

As to that point at which this method becomes uneconomical it would seem that pieces which do not recur at least four times might well be eliminated, that is, prepared on the job. Eventually, however, some one must measure and make up the piece, and if obstructions are relatively few the work proceeds much faster on the drafting board. Where leakage, say, of volatile solvents, is probable and testing of each piece is required, the testing is of course facilitated when a large number of pieces may be handled at one time. Under these conditions it may be advisable to include all pieces. For our use, because of discoloration, *2S* (99 per cent) aluminum is used, which is quite soft and unsuitable for flanges where leakage is a factor. Flanges throughout this installation were made of *51S* welded with 5 per cent silicon aluminum rod, which has proven entirely satisfactory in its year of service.

At first glance this method of laying out pipe would appear somewhat involved and probable of small annoying errors; however, with good checking on the board and in the shop these objections do not hold.


2'-9" for PC. MK. #1
2'-9" for PC. MK. #2
2'-0½" for PC. MK. #1
2'-9" for PC. MK. #2
90°
Holes straddle these ℄'s
3'-5" Approximate
7¾" R
PC. MK. #1
PC. MK. #2
2'-5½"
2" Pipe
7¾" R
3'-9"
PC. MK. #5
7'-6"
4'-5½"
3'-0½"
2" Pipe
2'-11" for PC. MK. #3
10⅜" for PC. MK. #4
PC. MK. #3
PC. MK. #4
10"
2" Pipe
"A"
17'-6½"
23'-7"
6'-0½"
PC. MK. #6
PC. MK. #6A
45°
Turn
METHOD FOR WELDING ALUMINUM FLANGES
This location for PC. MK. #6 - Rotate nozzle 90° clockwise for PC. MK. #6A
SECTION AA
This bend on PC. MK. 9 and 9A Bend on right as shown for PC. MK. 9 - on left for PC. MK. 9A
7¾" R
9½"
SECTION BB
5'-9½"
7¾" R
2'-0"
This bend looking down for PC. MK. #8A — looking up as shown for PC. MK. #8
2'-11½"
PC. MK. #8
PC. MK. #8A
6"
⅜" Plug-Weld-Both Ends
5" nozzle - This location for PC. MK. #7 - Rotate 180° for PC. MK. #7A
4" Pipe
3'-1"
PC. MK. #7
PC. MK. #7A
3-2" Nozzles
15'-0"
8"
11'-11½"
5'-0½"
PC. MK. #9 and 9A
PC. MK. #10
GENERAL NOTES
1. Material Steel or Aluminum as specified on purchase order
2. Aluminum Pipe - 25 Tubing - I.P.S.
3. Steel Pipe - Std. W.S.
4. Aluminum Flanges - 51S Plate
5. Alum. Flanges Welded to Tubing with 5% Silicon Rod
6. 3" Pipe unless otherwise specified
7. 3" Flanges - 7½" Dia. - 6" B.C.
8. 2" Flanges - 6" Dia. - ¾" B.C.
9. All drilling - ¾" - holes equally spaced as shown
10. Face of Alum. Flanges must be smooth
11. All Steel Flanges to be faced

**First sketches of the required assembly pipes called for 26 different pieces; this number was finally reduced to the 10 shown here. (This drawing indicates a 7¾-in. radius on 3-in. bends, later changed to a 4½-in. radius)**

# CONTROL

## *for a Steam-Jet*

# Air-Conditioning Unit

*By* **R. R. Houser***

***PROPER CONTROL** of a steam-jet air-conditioning unit supplied with steam generated intermittently is essential to satisfactory results. In fact, controls are most essential with any type of system, often are given too little attention . . . . . The control circuits for a small steam-jet unit, illustrated in the figure, are explained in detail here by the designer of the layout.*

CONTROLS are one of the most essential parts of any air-conditioning system, yet frequently too little attention is given them. They play as important a part in the operation of the system as the nervous system does in the human body. Failure to use adequate control equipment means failure in the results obtained.

One of the handicaps in the application of the steam-jet refrigeration principle to air conditioning has been in the method of control. Steam has been used successfully for many years for producing cold water for process, drinking, etc.; in most of these applications a constant supply of steam is available. Now it appears that steam-jet cooling may be the solution for summer air conditioning in many offices, stores, shops, residential buildings, etc., with the boiler which supplies steam for heating in winter also supplying steam to produce cold water by means of the steam-jet principle for air conditioning during the summer months. Cost of operation will be one of the determining factors.

Generation of steam for a steam jet intermittently, only as cooling is necessary, can effect a considerable saving. The average owner or supervisor of a small plant who expects to maintain the proper temperature summer and winter will set a thermostat indicator occasionally, but he will not give any more time to adjustment; he requires automatic operation.

### Operation of the Control

The wiring for a 6-ton steam-jet conditioning plant shown in Fig. 1 is giving satisfactory results in a small Kansas City store. Natural gas is the fuel used in the gas-designed boiler supplying steam for cooling the same area in the summer that is heated in the winter.

Units using only one steam jet must have a purge to create the initial vacuum before the unit is ready to receive the live steam. Otherwise, the steam would flow into the evaporator and heat the water intended to be cooled. The first stage in the cycle of operation then, must be the creation of a sufficient vacuum in the evaporator or flash tank so that the steam may pass unrestricted into the condenser as the steam valve is opened.

The primary control is a room thermostat, placed in the conditioned area, in command of the purge-pump motor through a relay and magnetic starting coil. As the temperature rises to the setting of the room thermostat a contact is made and the purge commences to pump a vacuum on the evaporator and condenser. One part of the gas-valve circuit is closed at the same time. When a predetermined vacuum is reached, the vacuum control closes the final break in the gas-valve circuit and allows this valve to open, thereby supplying gas for steam generation.

Pressure-control No. 1 will not allow the steam pressure to exceed 15 lb. Pressure-control No. 2 will open the steam valve when 13 lb of steam pressure is present in the supply line. The steam valve in turn controls the chilled-water-pump motor and cooling-tower pump and fan motors so that they operate only when the steam valve is open and cold water is being produced in the flash tank.

If, for any reason, steam should cease to flow through the jet and, instead, into the flash tank, the high-limit control will immediately close the steam valve.

When the room thermostat is eventually satisfied, its contact is broken, the holding relay breaks the gas valve and purge-pump motor circuits simultaneously. Since the gas supply is cut off, the boiler ceases to produce steam and pressure-control No. 2 closes the steam valve on loss of pressure. The steam valve stops the cooling-tower and chilled-water-pump motors. The same cycle is repeated on the command of the thermostat.

Winter air conditioning can be had by reversing switch No. 1 and opening the hand valve on the pipe supplying steam to the heating coils in the conditioning unit. The action of the thermostat will be reversed to make a contact on a drop in temperature. A circuit will be made then through the relay and pressure-control No. 1 to the gas valve, allowing steam to be generated and supplied to the heating coils.

*In Charge of Air Conditioning, Kansas City Gas Company, Kansas City, Mo.

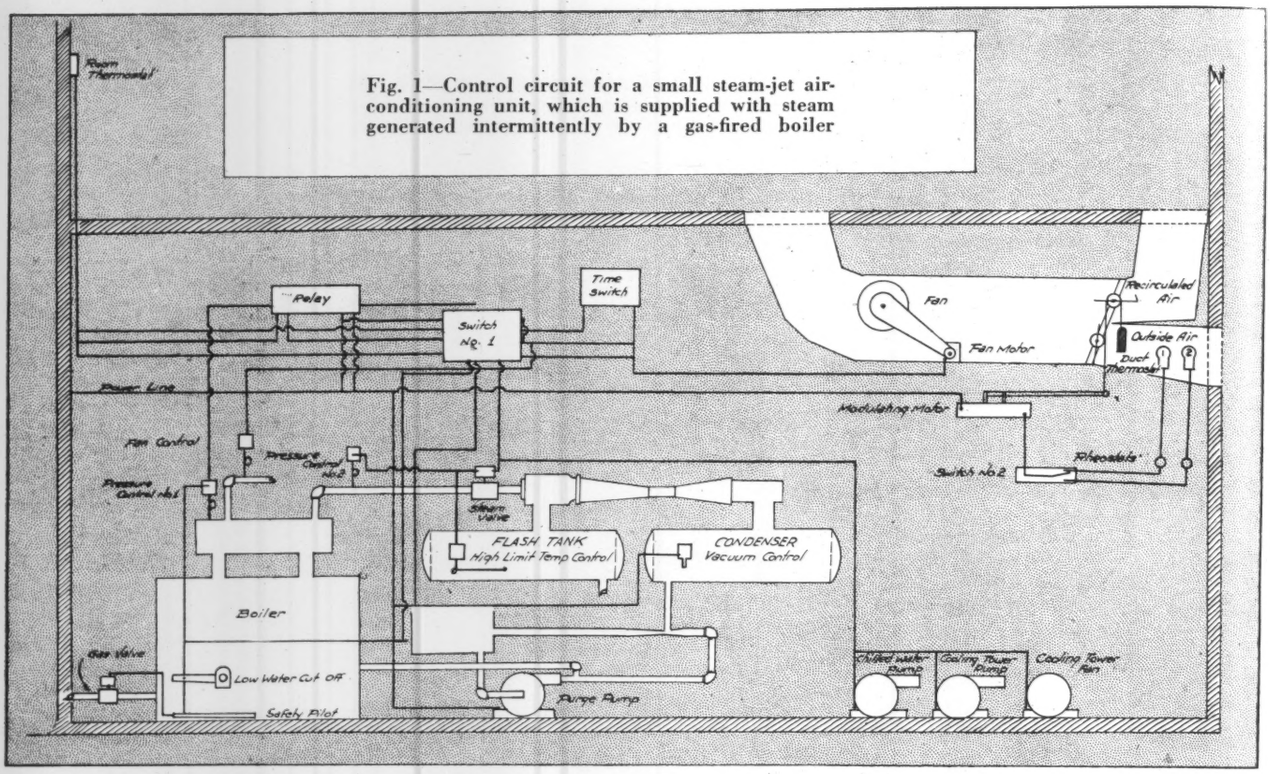



**Fig. 1—Control circuit for a small steam-jet air-conditioning unit, which is supplied with steam generated intermittently by a gas-fired boiler**

### Fan Controlled by Time Switch

The fan in the conditioning unit supplying air to the conditioned area is controlled by a time switch. Continuous operation of the fan is necessary for air circulation when the building is occupied. During hours of no occupancy at night, control of the fan automatically reverts to the fan control. This control makes the fan circuit only as steam is produced by the boiler. At a predetermined hour in the morning the time switch makes a circuit to provide again constant fan operation.

If switch No. 1 is in the summer position, the time switch serves another purpose. At the time corresponding to the hour in winter when air conditioning was not wanted, all circuits of the steam-jet unit are broken. A certain time in the morning is set for circuits to the cooling system to be made again.

### Amount of Outdoor Air Controlled

As there are many periods during the year when outside air can be supplied to the conditioned area to supplant the action of the air-conditioning unit, a method is shown in Fig. 1 for automatically controlling the amount of air brought in from outdoors and the amount to be recirculated in the space served. A modulating motor is used to operate an outside-air damper and a recirculating-air damper. Duct-thermostat No. 1 controls this motor in summer; by reversing switch No. 2, the second duct thermostat commands in winter.

The summer thermostat is so wound as to give one-half of its action, or a ninety-degree motion, between 70 and 80 F, and an additional ninety-degree motion between 70 and 65 F. If the outside temperature rises from 65 F to 70 F, the outdoor-air damper will rotate from a closed or vertical position to a full-open or horizontal position. The damper position is at any time in direct proportion to the temperature between 65 and 70 F. Similarly, the action from 70 to 80 F is from the full-open position on up until the damper is closed. The entire motion from 65 to 80 F is through a one hundred and eighty-degree arc. The recirculating damper is always in the reverse position in comparison with the damper in the outside-air duct.

The winter duct thermostat placed in operation by the reversing switch allows the outside-air damper to move from a full-open position at 65 F to the closed position at 30 F. The same relation exists between the damper position and outside temperature as is maintained by the summer duct thermostat.

### Allowing for Occupancy

The number of people in the conditioned area will affect the amount of outside air needed when the occupancy is great. Two rheostats are provided to take care of this condition. A manual setting of rheostat No. 1 will increase the amount of outdoor air introduced in summer. Rheostat No. 2 controls the damper in the winter. There may be a time during each day in the heating season when a complete "airing out" of the area served is desired. A turn of the rheostat stops recirculation of inside air and the full opening of the lower damper will allow a complete replacement with outdoor air.

The result obtained is the proper proportioning of outside to inside air, either in summer or winter. During the cooling season an overload on the cooling unit is

prevented by reducing the volume of outdoor air entering. Outside air below 65 F is also limited so that on cool, rainy days, recirculated air only is used.

### Results Secured with the System

If cooling equipment of the proper capacity is used there should be no complaint because the inside air is too warm for comfort. The low-temperature point should receive the most attention. Air conditioning has been severely criticized because the area conditioned was cooled too much. Cooling units with balanced capacities will allow the inside temperature to rise almost in direct proportion to an outdoor-temperature rise, maintaining approximately the same differential. This will aid in eliminating the body shock experienced when a person first passes into the space cooled, or upon going into the hot street temperature from a too-cool space.

Results with the control system described here indicate that:

1. A small gas-fired boiler supplying steam for heating in the winter and cooling by means of a steam jet in summer can be operated most economically by generating steam only as heating or cooling is needed.
2. Correct proportioning of outside and inside air will materially aid in raising the efficiency of an air-conditioning unit.
3. Control of the minimum temperature inside with relation to outdoor temperature is essential to producing comfort conditions. The maximum indoor condition will take care of itself if the cooling equipment is controlled by a room thermostat.

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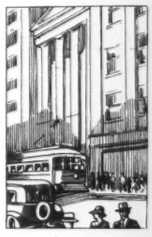
# Suggests Recovery Act Funds Be Used to Abate Smoke Nuisances

IN a memorandum recently submitted to the *American Society of Mechanical Engineers* and the *American Society of Heating and Ventilating Engineers,* Howard C. Murphy stresses the importance of preventing air pollution by smoke, and suggests the allotment of public funds under the National Industrial Recovery Act to assist municipalities and owners in eliminating smoke nuisances. Mr. Murphy is a member of the *A.S.M.E.* committee on setting heights of small boilers, whose code he mentions. The memorandum:

"My interest in the code for setting heights of small boilers is, of course, from the angle of the pure air committee and the abatement of city smoke. I have concerned myself with this subject for a number of years, being convinced of the tremendous industrial waste caused by the incomplete combustion of fuels. The dollar loss in wasted fuel is generally understood by engineers. The community expense is not so readily apparent. In smoky cities the laundry work is increased, durability of clothing is decreased, there is more work for doctors and hospitals, shade trees suffer, buildings require more painting and varnishing. In general, materials deteriorate much more rapidly in smoky cities than in clean ones. City smokes cause rapid deterioration in real-estate values; residents who can afford to, move to the suburbs, leaving a costly and crowded downtown center surrounded by a zone inhabited mainly by those who cannot afford to move away.

"More important than this, however, is the effect of city smoke on community health. The prevalence of rickets and similar disorders in modern childhood is undoubtedly traceable to smoke-polluted atmospheres. The effect of city smoke on respiratory diseases and on diseases of the nose, throat and eye is well understood.

"In common with many of those interested in municipal smoke-prevention work I have been convinced for some time that there will never be any real progress in smoke abatement while there are so many antiquated and poorly designed boilers and heating systems in use. Many of these installations are out of date, improperly designed and in their present condition will always constitute a smoke nuisance. Because many of these installations are in private or semi-private buildings, there has been a hesitancy on the part of the municipalities to force the owners to correct the condition.



"*Section 202* of the National Industrial Recovery Act provides for government aid in low-cost housing, slum clearance projects and similar activities which serve the interests of the general public. I believe the committee on setting heights, the *A.S.M.E.* and other interested agencies should place themselves on record as favoring the allotment of public funds to the extent and proportion provided in *Section 203* of the National Industrial Recovery Act, to assist the municipalities and/or owners in the elimination of these smoke nuisances. I believe that provision should be made that government aid will be extended only when the equipment is of approved design and erected in accordance with the national engineering codes.

"If the *A.S.M.E.* and all other interested agencies will take the necessary steps to bring this matter to the attention of the national emergency relief organization I believe that it will result not only in the creation of considerable employment but will be of direct benefit in the conservation of public health."

Yours very truly,

H. C. MURPHY.[1]

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## Importance of Smoke Elimination Presented in Forceful Style

Though by no means a "scare" book, one is almost afraid to breathe city air at all after reading *Stop That Smoke!* by Henry Obermeyer, assistant to the vice-president of the Consolidated Gas Company of New York City, (Harper Brothers, 289 pages, $2.50). The author has presented the case for smoke elimination in dramatic and forceful style. The harmful effects of smoke and fumes from the angles of public health, civic beauty, deterioration of property values, and economy in the utilization of fuels are considered, and quotations from many sources are given. The book, popular in style, is designed to be of service to civic organizations, as well as to individuals directly responsible for the creation of smoke. Most of the blame for pollution of the air by smoke is put on the small individual heating plant.

Not the least important chapters of the book are those on preventing the creation of smoke, among which are fuels and firing, principles of furnace care, and the shadow of the shovel.

[1]Vice-President American Air Filter Co., Inc., Louisville, Ky. Member of Board of Consulting and Contributing Editors.

# Heating and Ventilating Airplanes

HEATING and ventilation are twin problems which still remain unsolved to the complete satisfaction of the air transportation industry. With passenger traffic on the 50,000-mile network of air line routes being flown by American companies in the western hemisphere showing almost constant increases, comfort of the passenger is a consideration of paramount importance. Consequently the subject of proper heating and ventilating is now receiving greater attention than at any time since the facilities of the scheduled air-transport lines were opened to passengers.

**Planes on cross-continental routes encounter temperatures ranging from —20 to 100 F, indicating the importance of provisions for maintaining even cabin temperatures. This is a Wasp-powered Ford tri-motor plane of the Transcontinental and Western Air, Inc.**

Air transportation is one of the few industries which have continued to push ahead during the period of depressed business conditions. During 1932, the principal air lines ordered and completed plans for large fleets of new, faster and more comfortable transport planes. Early in 1933, air lines flying the American flag had 655 transport planes in service. The first of the new planes ordered, with cruising speeds of from 145 to 200 miles an hour, started their regular runs with the opening of the 1933 summer season. Before the end of the year, more than 125 new transports, carrying from 8 to 15 passengers, will be added to the present fleets; 1934 promises to offer further expansion.

### The Aircraft Heating and Ventilating Problem

While aircraft heating and ventilating problems are not confined to the big transport planes which fly on the regular services of the scheduled lines, the need for research and study is felt more acutely by the operations and maintenance executives of such lines, who must insure a high standard of service for passengers summer and winter, night and day, in warm climates and cold climates.

The unique character of the problem can be seen when it is realized that a transport air liner, climbing to 10,000 ft in about 12 minutes, may experience a range of temperature from 70 F to well below 0 F. Thermostatic control is obviously desirable to insure maintenance of the desired cabin temperatures during such rapid change and to relieve the pilot of one of his many duties. Because of the high premium placed on weight and space in all aircraft (some estimates valuing each pound of weight saved at $100), it is absolutely necessary that the heating and ventilating system require as little space as possible with minimum weight.

The best heating systems already employed in transport aircraft have provided adequate heating for average temperatures, but often the heat supplied is insufficient when very low outside temperatures prevail. Proper regulation of the amount of heat to maintain comfortable temperatures at all times has been found difficult. The distribution of the heat supply throughout the cabin and pilot's compartment requires constant attention to maintain even temperatures when the outside air temperature is low. An adequate system should maintain a temperature of at least 70 F in the cabin, 60 F in the pilot's cockpit, when the outside air temperature is —20 F. In addition to providing these temperatures, the heated air should be clean and pure, and the system should have adequate control, either manual or preferably thermostatic. Proper ventilation is of equal importance in hot weather, and the passenger-cabin ventilation system should provide a supply of about 1,500 cfh per person; it should be possible in flight to keep the interior of the passenger cabin at a temperature no more than 4 F in excess of that of the outside air.

*By* **William E. Berchtold***

***MUCH REMAINS** to be done in solving the complex problems in heating and ventilating aircraft. Inherently it's a difficult job; when the magnitude of the air-transportation industry is realized, its importance is self evident....The author, who has recently completed a study of the question, here outlines the problem, shows how it is being met, tells what there is to do.*

●

## Present Methods of Heating Planes

The oldest and most commonly used heater is the hot-air-exhaust type, either employing shrouds around the exhaust pipes, metal insert tubes inside it, or both. The desire to utilize the high temperature of the engine exhaust (which averages around 1200 F in a 575-hp radial engine at cruising speed) to reduce the heater units to minimum size and weight has directed the trend of developing the hot-air-exhaust type heater. Such heater assemblies weigh from 18 to 30 lb for a 10- to 15-passenger cabin air liner. With planes having passenger capacities of 12 persons or more, it has been found necessary to take hot air both from around and within the exhaust pipe to provide sufficient heat for average winter conditions.

Chief disadvantages of the hot-air-exhaust type heating system are concerned with problems of proper construction and maintenance, among which the prevention of leaks comes first. It has been difficult to find a metal which will stand the expansion and contraction of the intensifier tubes which are exposed to direct exhaust flame inside the exhaust pipe. In an effort to prevent the eventual breakdown of these tubes, one line has adopted the use of cold-rolled or 1020 steel tubing of 0.065 gage or heavier. It has been found practically impossible to make installations on some planes of intensifier tubes which can be removed for inspection without cutting them out. It has been necessary to use welded joints on the intensifiers, necessitating a very high-grade welding job to insure a leak-proof assembly. Because of the danger of carbon monoxide gas entering the passenger cabin as the result of a leaky joint, most lines have discontinued the use of inner exhaust sleeves and are employing only the outer exhaust pipe sleeve or jacket.

Proper distribution of heat in the cabin constitutes another problem with hot-air-exhaust heaters. In the earlier transport planes, the hot-air inlets or grids were located in the floor, either in the aisle or beneath the passenger's feet. It was soon found that in this position, the grids were not only effective collectors of dust and dirt — which was blown out whenever the grid was opened—but that they soon became stuck and were rendered useless as the result of constant tramping beneath the feet of passengers. It was likewise found that individual shutters became jammed when the hot-air ducts were laid along the cabin floor from front to rear between the legs of the chair. The most desirable location for the heater inlet is along the side of the wall close to the seat and about 5 in. off the floor, with holes of such size and location to deliver the correct amount of heat and blow it out and slightly down. However, complaints of uneven heat distribution are still received from passengers.

Successful control of the hot-air-exhaust type heating system has been a major problem. To provide for varying temperatures, a control is necessary which will permit either all of the available heat to enter the cabin, or which will regulate the hot- and cold-air mixture to provide a proper cabin temperature, or completely exclude the heat from the cabin if necessary. This requires a control which will entirely shut-off the heat from entering the cabin, and at the same time by-pass the heated air to the outside atmosphere. It is essential that the air in the intensifier tubes and heater shrouds be kept in circulation at all times. The control valve, therefore, is so designed that this circulation may continue regardless of the disposition of the heated air. Because the design of satisfactory thermostatic controls within weight limitations has been found difficult, most of the transport planes equipped with hot-air-exhaust type heaters use manual controls requiring constant attention.

## Liquid and Vapor Systems Are Promising

The major air lines are interested in the development of some kind of liquid or vapor heating system as the most practical solution of their heating problems. Advantages are the elimination of the danger of leaking gases, probable weight reduction, and—it is hoped—simplified problems of affording quick and positive control, effective distribution and reduced maintenance costs. Another factor which dictates the turning from the hot-

**Heating and ventilating engineers are faced with new problems in providing adequate systems for aircraft. This high-speed Boeing low-wing monoplane cruises at 158 mph, reaches a top speed of 185**

*Manager of the Air Transport Section of the Aeronautical Chamber of Commerce of America, New York City.

air-exhaust type system is the trend toward twin-motored planes, with engines mounted on the wings. The hot-air system is limited to planes having an engine in the nose of the fuselage, as added weight and loss of heat prevent piping hot air to the cabin from exhaust pipes of outboard engines.

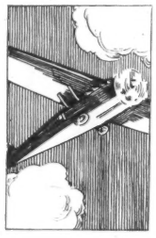
Several hot-liquid heating systems have been tried experimentally with varying results, but only recently has it been that a serious approach to a scientific study of this kind of heater has been attempted. It deserves further study by heating engineers interested in the problem. The hot-liquid heater is operated on the same principle as the hot-water heating systems used in buildings. The liquid used may be quenching oils of high boiling point, ethylene-glycol (commercially known as prestone), or any other liquid which has a boiling point of more than 300 F, which will not freeze or congeal at -20 F, has a flash point high enough to guard against a fire hazard in case of leaks, and which is non-corrosive. Since the weight of the radiator goes up as the temperature difference between liquid and air is reduced, it is not considered economical to use a liquid with a lower boiling point than 300 F. The heater may be constructed as a series of coils in the enlarged exhaust stack, as a tube running through the manifold, or as an independent unit through which some of the exhaust gases are by-passed. The hot-liquid-type system is easily adapted to planes having outboard engines since the liquid can be circulated through insulated pipes to any desired location for radiation. In one installation, tubes were permitted to carry the hot liquid around the cabin inside air ducts which had individual openings. This was found to be inferior to a unit radiator because it subjected passengers to the danger of being scalded in the event of failure of a pipe or fitting during service or in a crash.

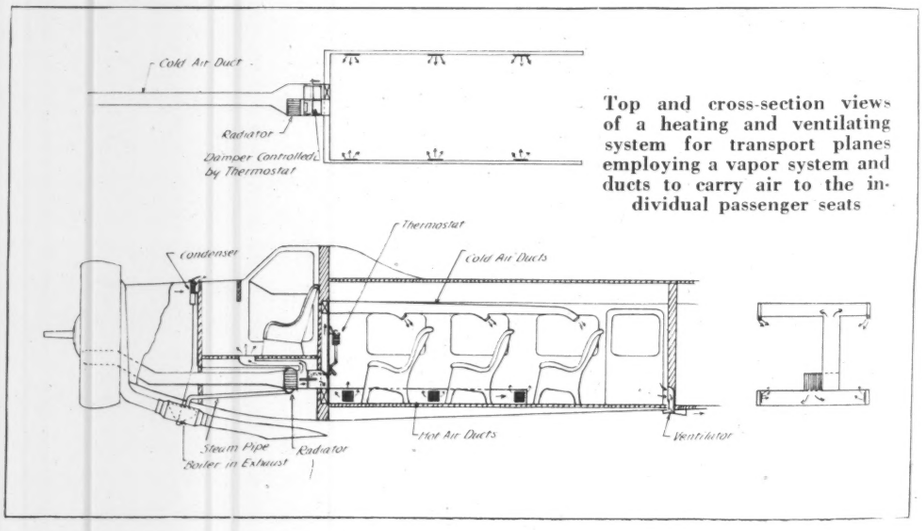
More and more attention is being given to the possibilities of some form of vapor-heating system. One of the most promising consists of a radiator with motor and fan, a condenser and reservoir, and a boiler located in the exhaust system. Its principle of operation differs from the conventional steam-heating system in that the quantity of steam generated is controlled by automatically varying the amount of liquid in the boiler instead of regulating the heat to the boiler. The ramming effect of the slipstream when the airplane is in flight may be substituted for the use of the fan, although care must be taken to limit the air flow to the quantity desired.

### Plane Ventilation Research Needed

Ventilation offers problems just as serious as heating. Perhaps one of the principal faults of experiments in aircraft heating and ventilating to date has been the general failure to consider the two problems as one. Experience has shown that each type of transport plane has a definite motion of air in its cabin — usually from the rear forward in high-wing monoplanes—and it is necessary to study this condition before locating suction vents, which should be placed at the opposite end of the cabin from the neutral air exit. Recirculation of cabin air has been tried in an effort to cut down the effect of rapid changes in outside air and materially reduce the weight of heating units, but the innovation proved undesirable because of the recirculation of odors from occasional cases of air-sickness.

Various types of ventilators have been tried, but have been found wanting in one respect or another. Ventilators employing an air intake in the wings and distributed through ducts opening into the passenger cabin have been used to provide odor-free, clean, pure air for passengers. One ventilator in use delivers a small high-speed stream of air directly controllable by each passenger through two 90-deg pipe elbows facing in opposite directions and held together by a pipe nipple mounted in the side of the fuselage directly above and slightly forward of each seat. It is considered valuable as a tonic to revive a person stricken with air-sickness, but destroys the regular process of air circulation necessary to good ventilating. Such an accessory system of ventilators, which also have the disadvantage of admitting rain when turned to the "on" position, are considered necessary now, but might easily be eliminated in a well-designed ventilating system. No ventilation system has yet been developed properly to care for the needs of passengers in the tropics when the plane is at rest on a sun-flooded sea, which affords some real opportunities for research to develop an artificial cooling or air-conditioning-system.






**Top and cross-section views of a heating and ventilating system for transport planes employing a vapor system and ducts to carry air to the individual passenger seats**

# *Detroit Edison Engineers Present Graphs for*

# Design *of* Piping *for* Flexibility

OUTSTANDING as a contribution to piping design is the paper "The Design of Piping for Flexibility by the Use of Graphs," presented by E. A. Wert,[1] S. Smith,[2] and E. T. Cope[3] at the semi-annual meeting of the *American Society of Mechanical Engineers* in Chicago last June. It has been privately printed in book form (183 pp., 8½x11, reproduced from typewritten pages) and a second revised edition is now in preparation. An abstract prepared by the authors summarizes the paper as follows:

"The designer of piping which is to carry hot fluids must answer several questions if he is to produce a best scheme of piping. This scheme of piping must be so designed that the point of maximum bending moment is known. The value of the maximum bending moment must also be known. This maximum bending moment should be such that the resulting stress due to bending alone is a maximum value as dictated by good practice, taking into account the material of which the pipe is constructed and the temperature at which the pipe is to operate. The elements of the pipe structure must be so proportioned that the limitations of the available space may be satisfactorily met and the thrusts at the anchor points may be within the limiting value set by the characteristics of the supporting building or other structure. There have been tests made which show that, for piping in one plane, there is satisfactory agreement between the tested flexibility of a pipe taken from stock and the calculated flexibility of its ideal counterpart, except in the case of torsional loading applied at the end of a quarter bend having tangents. The ideal pipe is assumed to be made of homogeneous metal and to be of true and uniform circular cross-section. The bends are assumed to be true arcs of circles. The metal of the pipe is assumed to possess average elastic and thermal characteristics. The actual pipe, if in the form of a tangent, may be expected to conform within 5 per cent of the ideal. If in the form of a quarter bend with tangents, the actual pipe may depart as much as 15 per cent from the ideal. In both shapes the actual pipe is more flexible than its ideal counterpart. This is on the safe side.

"The mathematical analysis necessary to be carried out in determining the deflection and reaction characteristics of the ideal pipe has been developed to such a state that it is a dependable tool. It is, however, rather involved and requires the consumption of considerable time in its application. For some time it has been evident that an accurate, rapidly-applied method of analysis for pipe structures would be of great help to the piping designer. The method had best be graphical in so far as possible. It should further be general in its application. It should require the least possible number of arithmetical operations and the use of the fewest practical number of tables. If graphs are used, they should be based on accurate mathematical calculations and should be so plotted that the values may be read from them to within a very low percentage of error. This paper presents the graphs and tables necessary for the rapid, accurate determination of the proper lengths of the elements of nine forms of flexible member lying in one plane and made of smooth pipe. These graphs apply to pipe structures which are designed to operate at any temperatures. From these and supplementary graphs the stress at the point of maximum bending moment and that at the point of maximum stress, caused by the thrusts at the anchor points, may be computed. These thrusts result from the change of length of the elements when the temperature of the piping is raised by the passage of hot fluid. The value of the thrust or anchor reaction may be computed. There is also presented a set of graphs by the use of which the correct choice of pipe shape may be determined, in order that the greatest expansion-absorbing capacity with allowable stress and anchor reaction may be secured.

***NOW THAT the value of a careful analysis and design of a piping system for flexibility is well established, designers are in need of simplified methods to save time, reduce the probabilities of error, permit wider application of mathematical treatment.....Such a method was presented in a recent A.S.M.E. paper, is reviewed here.***

"There are several assumptions made in the carrying out of the preparation of the graphs, the supporting calculations, and the tables of constants. These assumptions are, first, the constants (the modulus of elasticity and the coefficient of thermal expansion) apply to mild steel only. If any other metal is considered, the correct values of these two constants must be used. Second, the value of the modulus of elasticity $E$ of the steel of which the pipe is made conforms to the law proposed by George Orrok. Third, the value of the coefficient of thermal expansion follows the law of Holborn and Day. Fourth, the pipe structure was installed at a temperature of 60 F, and neither thrusts nor moments were set up at the anchor points by the assembling operation. Fifth, the anchor points provide perfect rigidity. This condition is not met perfectly in actual installations. It is, however, assumed to be met. Sixth, the pipe structure is not restrained except at the anchor points. Seventh, the cross section of the pipe is uniform and circular, and all bent lengths are true arcs of a circle. Eighth, all parts of the structure have been relieved of local stresses set up during fabrication, so that each element reacts as a perfectly elastic body. The use of the graphs and tables of constants as applied to the nine pipe shapes shown in Fig. 1 of the paper are discussed in order. The mathematical basis for each graph is explained briefly in an appendix, to which adequate reference is made. All general symbols used are defined in a table. In all the cases of pipe shape there are two general problems presented. These are, first, that arising in the design of a new piping scheme and, second, that arising in the study of an existing pipe structure. In general for all shapes, in problem 1, the allowable maximum stress and the length of one or two elements are given to find the length or lengths of the other elements and the forces at the anchor points. In problem 2, the dimensions of all elements of the structure are given to find the maximum stress and the forces exerted at the anchor points."

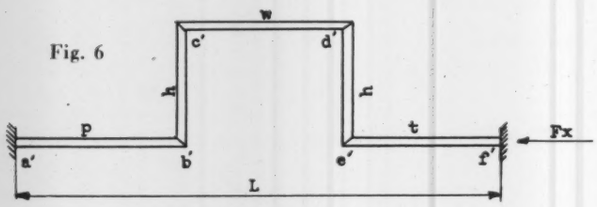
[1]Piping Division, Drafting and Surveying Bureau, The Detroit Edison Company, Detroit, Mich.
[2]Piping Division, Drafting and Surveying Bureau, The Detroit Edison Company.
[3]Research Department, The Detroit Edison Company.

## Solution of a Piping-Flexibility Problem

To show how the information and data given in this paper may be applied, and to indicate the method of designing a piping system for flexibility by the means proposed, a typical case (*Case E—The Expansion U-Bend Having Square Elbows*) is published here. The figures and tables needed in the solution of this case are also reproduced, the figure numbers being those of the original paper.

The structure shown in Fig. 6 is the limiting shape of expansion U-bend, since the radii of curvature at the points of directional change are zero. The elastic behavior of this pipe structure approximates closely that of one of similar shape, but having the square elbows

Fig. 6




replaced by 90-deg ells or tees of ordinary proportions made of cast metal.

In Fig. 6, the ends of the structure are assumed held rigidly, so that the elongation of the elements, when hot fluid is introduced into the pipe, is forced back into the structure and results in the anchor reactions.

The curves and equations used in the study of this shape of structure are given on Plates 7 and 8. The mathematical development of these curves and equations is given in Appendix V. (Not published here.) In the mathematical development of the equations, the lengths $p$ and $t$ disappear, indicating that the loop may be located anywhere between the points $a'$ and $f'$ without changing the values of maximum stress or anchor reactions.

Two concrete problems are solved to show the use of the curves and equations in finding the values of the unknown lengths, of the force $F_x$, or of maximum bending stress. The first of these problems arises in the design of a piping layout and is called *Problem 1*. The second arises in the study of the maximum bending stress and the anchor reactions in an existing or assumed pipe structure and is called *Problem 2*.

*Problem 1* is illustrated by the following example:

| | |
|---|---|
| 1. Steam temperature | 500 F |
| 2. Pipe size (nominal) | 6 inches |
| 3. Weight of pipe | 400 lb, W.S.P. seamless |
| 4. Material of pipe | Mild steel |
| 5. Maximum bending stress | 12,000 lb per sq in. |
| 6. Length of structure $L$ | 80 ft, 960 in. |
| 7. Length of element $w$ | 20 ft, 240 in. |

The problem is to find the length of the element $h$ and the value of the anchor reaction, $F_x$.

First, the length of the element $h$ will be found by the use of the stress equation:

$$\text{Stress} = 15Ee\frac{D}{w} - c$$

by the following procedure: The value of $Ee$*, taken from Table 1-A, is 85,385 for 500 F. The values of $w$ and $D$*, in inches, given in the data, equal $\frac{240}{6.625} = 36.25$.

The numerical values to be substituted in the stress equation are:

| | |
|---|---|
| Stress = 12,000 | Data |
| $Ee$ = 85,385 | Table 1-A, 500 F |
| $D$ = 6.625 | Data |
| $w$ = 240 | Data |

Substituting these values in the stress equation, there is obtained:

$$12{,}000 = \frac{15 \times 85{,}385 \times 6.625}{240} c$$

Solving:

$$c = 0.34$$

From the ordinate value of $c$ on Plate 7, project horizontally to intersect the $L = 4w$ curve ($L = 4w$, since $\frac{L}{w} = \frac{80}{20}$ from data), and read the abscissa of this point of intersection, which is $\frac{w}{h}$ and equals 3.0. Since $w$ is 240 inches and $\frac{w}{h}$ is 3.0, the value of $h = \frac{240 \text{ in.}}{3} =$ 80 inches = 6 ft, 8 in.

The value of the anchor reaction is obtained by the use of the equation for force given on Plate 8, which is:

$$\text{Force} = 3EcI\frac{c}{h^2}$$

The value of $Ee$ is obtained from Table 1-A and is 85,385 for 500 F, the value of $I$ is obtained from Table XIV and is 28.84 for 6-inch, 400 lb, W. S. P. seam-

*$E$ is modulus of elasticity, $e$ is coefficient of thermal expansion, combined for convenience in Table 1-A.
$D$ is outside diameter of pipe.

TABLE I-A

Value of Ee for Mild Steel[1]

| Temperature F | Ee | Temperature F | Ee |
|---|---|---|---|
| 100 | 7,530 | | |
| 200 | 27,175 | 600 | 103,080 |
| 220 | 31,108 | 620 | 106,280 |
| 240 | 35,160 | 640 | 109,490 |
| 260 | 39,088 | 660 | 112,840 |
| 280 | 42,989 | 680 | 115,730 |
| 300 | 46,962 | 700 | 118,920 |
| 320 | 50,940 | 720 | 121,840 |
| 340 | 54,834 | 740 | 124,620 |
| 360 | 58,585 | 760 | 127,140 |
| 380 | 62,657 | 780 | 129,760 |
| 400 | 66,211 | 800 | 132,140 |
| 420 | 70,361 | 820 | 134,560 |
| 440 | 74,007 | 840 | 136,540 |
| 460 | 77,951 | 860 | 138,850 |
| 480 | 81,392 | 880 | 140,470 |
| 500 | 85,385 | 900 | 142,180 |
| 520 | 89,140 | | |
| 540 | 92,548 | | |
| 560 | 96,114 | | |
| 580 | 99,562 | | |

Note - 1. Value of E taken from PSP 50-32 Transactions A.S.M. E.

Value of e calculated from formula of Holborn and Day.

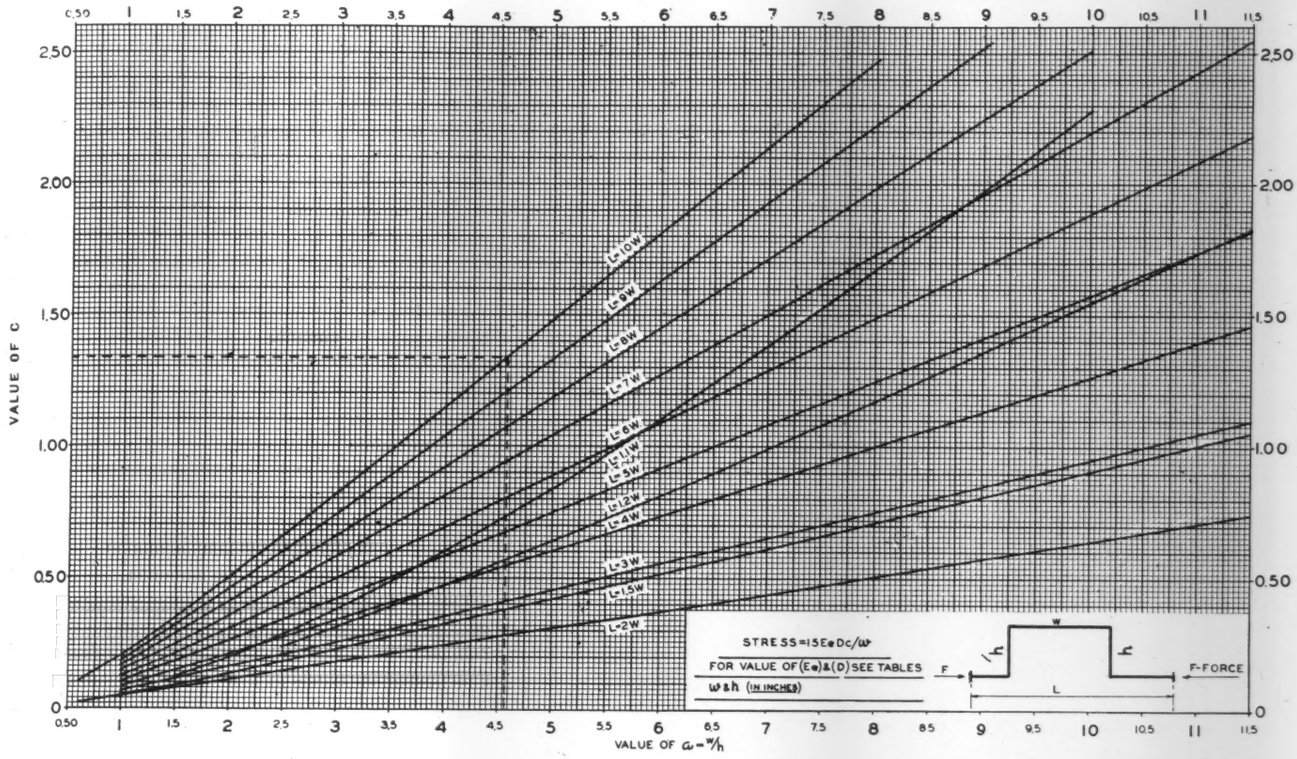



Plate 7

less pipe, the value of $h$ is 80 inches, obtained in the preceding paragraph. The value of $c$ is obtained from Plate 8 by the following procedure: The value of $\frac{w}{h}$ is 3.0, obtained in the preceding paragraph. From the point 3.0 on the abscissa scale of Plate 8, project vertically to intersect the $L = 4w$ curve, and read the ordinate of the point of intersection. This is the value of $c$ sought and is 1.58.

The numerical values to be substituted in the force equation are:

| | |
|---|---|
| $Ee = 85{,}385$ | Table 1-A, 500 F |
| $I = 28.83$ | Table XIV for 6-inch, 40 lb, W.S.P. seamless |
| $h = 80$ | Data |
| $c = 1.58$ | Calculated |

**TABLE XIV**

**Dimensions, Weights and Moments of Inertia of Lap-Welded and Seamless Steel Pipe 250, 400, 600, 900 and 1350 lb per sq in. Service Steam Pressure**

**(Dimension taken from Table I of A.S.T.M. - A-106-29.)**

| Working[1] Steam Pressure / Hydrostatic Test | | 250 lb. 750 lb. | | 400 lb. 1000 lb. | | 400 lb. 1000 lb. | | 600 lb. 1500 lb. | | 900 lb. 2000 lb. | | 1350 lb. 3000 lb. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size Inches | Outside Diameter Inches | Wall Thickness Inches | Moment of Inertia In.⁴ | Wall Thickness Inches | Moment of Inertia In.⁴ | Wall Thickness Inches | Moment of Inertia In.⁴ | Wall Thickness Inches | Moment of Inertia In.⁴ | Wall Thickness Inches | Moment of Inertia In.⁴ | Wall Thickness Inches | Moment of Inertia In.⁴ |
| | | Seamless Low or Medium Carbon Pipe | | | | | | | | | | | |
| 1 | 1.315 | 0.133 | 0.08734 | | | 0.133 | 0.08734 | 0.179 | 0.1056 | 0.179 | 0.1056 | 0.21875 | 0.1177 |
| | | Lap-Welded Open Hearth Pipe | | | | Seamless Low or Medium Carbon Pipe | | | | | | | |
| 2 | 2.375 | 0.154 | 0.6657 | 0.218 | 0.8679 | 0.167 | 0.710 | 0.1875 | 0.7764 | 0.250 | 0.9553 | 0.3125 | 1.102 |
| 2½ | 2.875 | 0.203 | 1.530 | 0.276 | 1.924 | 0.203 | 1.530 | 0.217 | 1.611 | 0.276 | 1.924 | 0.375 | 2.353 |
| 3 | 3.500 | 0.216 | 3.017 | 0.300 | 3.894 | 0.216 | 3.017 | 0.241 | 3.294 | 0.3125 | 4.014 | 0.40625 | 4.807 |
| 4 | 4.500 | 0.237 | 7.233 | 0.337 | 9.610 | 0.237 | 7.233 | 0.28125 | 8.332 | 0.375 | 10.42 | 0.500 | 12.76 |
| 6 | 6.625 | 0.280 | 28.14 | 0.432 | 40.49 | 0.288 | 28.84 | 0.385 | 36.87 | 0.500 | 45.40 | 0.6875 | 57.25 |
| 8 | 8.625 | 0.322 | 72.49 | 0.500 | 105.7 | 0.34375 | 76.80 | 0.46875 | 100.2 | 0.625 | 126.4 | 0.875 | 162.0 |
| 10 | 10.75 | 0.365 | 160.7 | 0.500 | 212.0 | 0.395 | 172.5 | 0.53125 | 223.0 | 0.750 | 295.9 | 1.0625 | 383.7 |
| 12 | 12.75 | 0.375 | 279.3 | 0.500 | 361.5 | 0.500 | 361.5 | 0.625 | 438.7 | 0.875 | 578.7 | 1.21875 | 742.2 |
| 14 | 14.00 | 0.40625 | 401.1 | 0.625 | 588.6 | 0.500 | 483.8 | 0.65625 | 614.0 | 0.9375 | 825.0 | 1.34375 | 1082 |
| 16 | 16.00 | 0.46875 | 690.3 | 0.6875 | 971.3 | 0.53125 | 773.3 | 0.750 | 1047 | 1.03125 | 1365 | 1.500 | 1815 |
| 18 | 18.00 | 0.500 | 1053 | 0.750 | 1515 | 0.59375 | 1231 | 0.8125 | 1623 | 1.15625 | 2180 | 1.6875 | 2907 |
| 20 | 20.00 | 0.5625 | 1624 | 0.875 | 2409 | 0.625 | 1787 | 0.90625 | 2483 | 1.28125 | 3316 | 1.84375 | 4378 |
| 24 | 24.00 | 0.625 | 3137 | 0.9375 | 4524 | 0.750 | 3705 | 1.03125 | 4917 | 1.500 | 6740 | 2.1875 | 9005 |

Note - 1. Service Steam Pressure in lb per sq in. gage.

Substituting these values in the force equation and solving, there is obtained:

$$\text{Force} = \frac{3 \times 85{,}385 \times 28.84 \times 1.58}{80^2} = 1{,}820 \text{ lb}$$

Thus, the required values are obtained.

*Problem 2* is illustrated by the following example:

| | |
|---|---|
| 1. Steam temperature | 500 F |
| 2. Pipe size (nominal) | 6 inches |
| 3. Weight of pipe | 400 lb, W.S.P. seamless |
| 4. Material of pipe | Mild steel |
| 5. Length of element $L$ | 190 ft, 2,280 inches |
| 6. Length of element $w$ | 19 ft, 228 inches |
| 7. Length of element $h$ | 7 ft, 84 inches |

The problem is to find the value of the maximum stress due to bending and the anchor reactions.

The value of the stress is obtained by the use of the equation for stress:

$$\text{Stress} = 15Ee\frac{D}{w}c$$

given on Plate 7. In this equation the value of $Ec$, found on Table 1-A, is 85,385 for 500 F; the value of $w$ is 228 inches, and of $D$ is 6.625 inches, given in the data.

The value of $c$ is obtained from the curves on Plate 7 as follows: Find the value $\frac{w}{h} = 2.71$ ($\frac{w}{h} = \frac{19}{7}$ from the data and equals 2.71) on the abscissa scale of Plate 7, project vertically to intersect the $L = 10w$ curve ($L = 190$ and $w = 19$ from the data), and read the ordinate of this point of intersection. This is the value of $c$ sought and is 0.73.

The numerical values to be substituted in the stress equation are:

| | |
|---|---|
| $Ee = 85{,}385$ | Table 1-A, 500 F |
| $w = 228$ | Data |
| $D = 6.625$ | Data |
| $c = 0.73$ | Plate 8 |

Substituting these values in the stress equation and solving:

$$\text{Stress} = \frac{15 \times 85{,}385 \times 0.73}{344} = 27{,}179 \text{ lb per sq in.}$$

The value of the anchor reactions $F_x$ is obtained by the use of equation given on Plate 8 which is:

$$\text{Force} = 3EeI\frac{c}{h^2}$$

In this equation, the value of $Ee$, taken from Table 1-A, is 85,385 for 500 F; the value of $I$, taken from Table XIV, is 28.84 for a 6-inch, 400-lb, W. S. P., seamless pipe, and the value of $c$ is obtained from Plate 8 in the following manner: From the point $\frac{w}{h} = 2.71$ ($w = 19$ and $h = 7$ from the data, then $\frac{w}{h} = 2.71$) on the abscissa scale of Plate 8, project vertically and intersect the $L = 10w$ curve ($L = 190$, $w = 19$, from data). The ordinate of this point of intersection, 3.10, is the value of $c$ to be substituted in the equation for force.

The numerical values to be substituted in the force equation are:

| | |
|---|---|
| $Ee = 85{,}885$ | Table 1-A, 500 F |
| $I = 28.84$ | Table XIV, 6-inch, 400 lb, W.S.P. seamless |
| $h = 84$ | Data |
| $c = 3.10$ | Plate 8 |

Substitute these values in the equation for force and solve.

$$\text{Force} = \frac{3 \times 85{,}385 \times 28.84 \times 3.10}{84^2} = 3{,}250 \text{ lb}$$

These values satisfy the requirements of this problem.

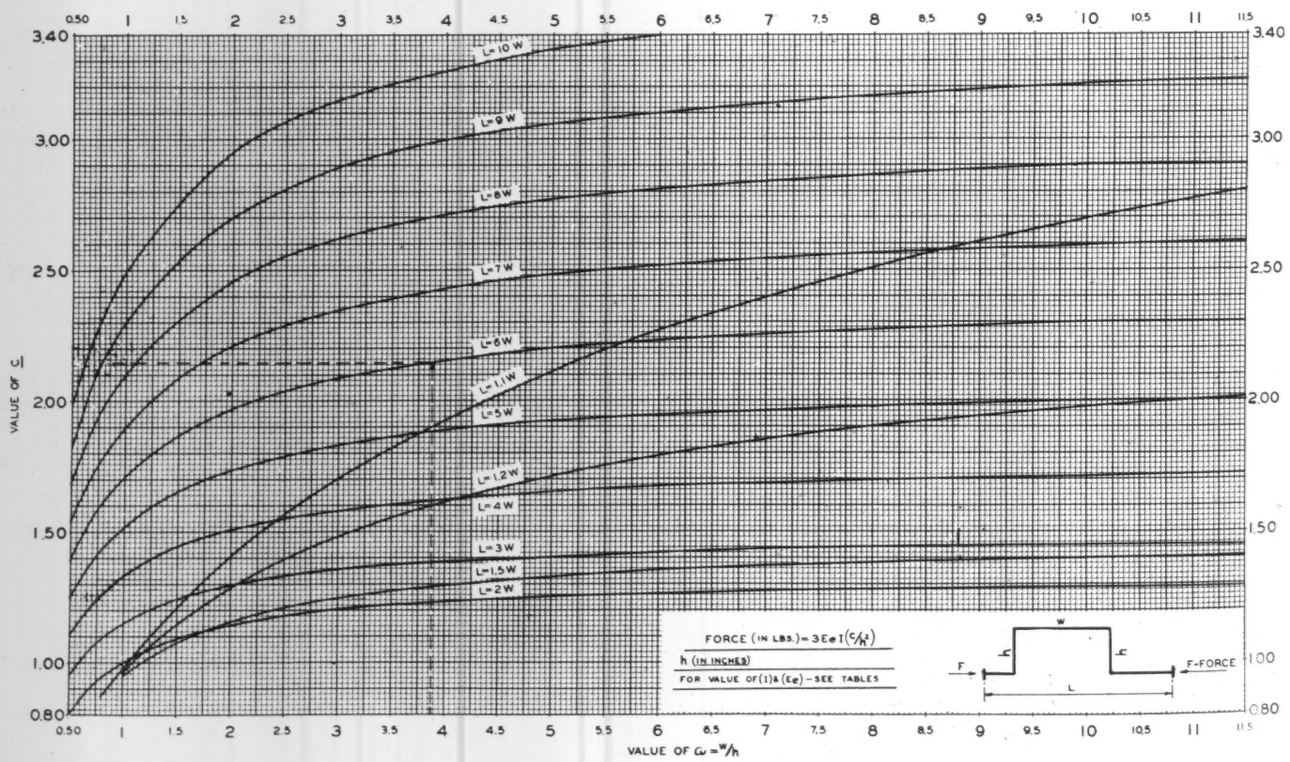



Plate 8

# Flexibility a Feature

## of the

## *Completely Conditioned*

## Philadelphia Saving Fund Society Building

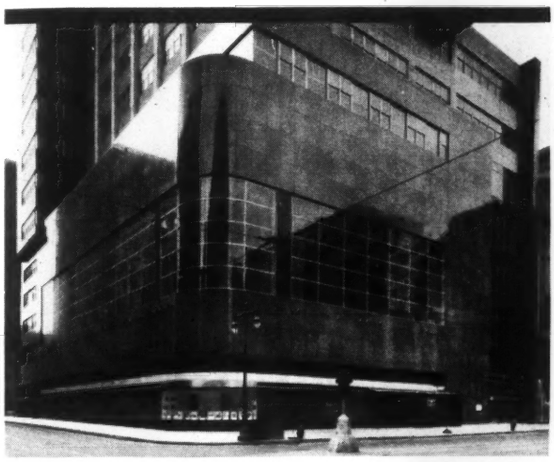


Fig. 1—Exterior view of the banking quarters on the second floor of the new Philadelphia Saving Fund Society building, giving an idea of the unusually large glass exposure areas which complicated the air conditioning

*COMMENDABLE FORESIGHT on the part of the owners of the new Philadelphia Saving Fund Society building required that it be thoroughly modern, hence completely air conditioned.... An unusually large glass exposure, varied nature of the tenancy, complicated the job, the solution of which is described in this article.*

*By . . .* **Joseph M. Dowling***

A TRIBUTE to modern practice in design and equipment of office buildings, the new 34-story structure[1] of the Philadelphia Saving Fund Society (formally opened in the autumn of 1932) offers to tenants the comfort of the first completely air-conditioned general office building on the Atlantic Seaboard. All spaces but toilet rooms and elevator lobbies are conditioned.

The unusually large exposure of glass surface and the varied nature of the tenancy offered problems in the design of the air-conditioning system which were carefully considered in providing a system which is flexible, yet economical and relatively simple to operate. It is the intent of this article to describe how these problems were handled, describe the zoning of the system to care for the shifting sun effect, etc.

### Zoning the System to Hold Sliding Scale

Net area conditioned is 345,860 sq ft, requiring an estimated total fan supply of 350,000 cfm when completely occupied. From Table 1 it will be noted that this air quantity has been fixed to hold a sliding temperature scale that will provide a maximum of comfort with changing outside conditions.

The success of any air-conditioning system depends largely upon the operation. In order to vary the inside conditions with changes in outside temperature (as outlined in Table 1) it was necessary to design a control arrangement that would require minimum adjustment and impose no impossible demands on the operator. With this point in view, the control was made completely automatic, except for the nine return-air thermostats at the dehumidifiers which are adjusted to suit the outside conditions, and the zone thermostats for the typical office floors.

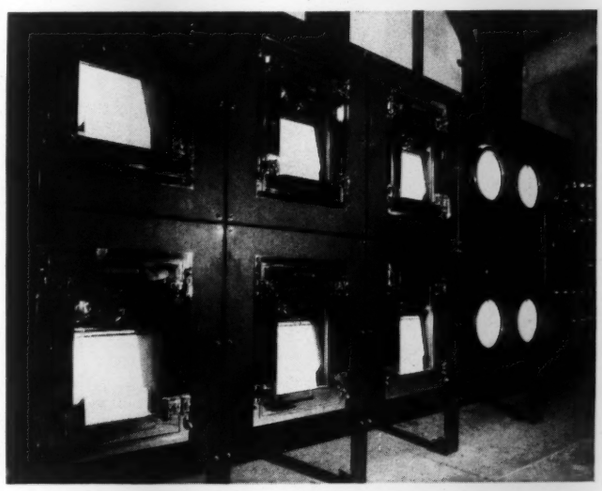


Fig. 2—These 72-point recording instruments aid the simple, efficient operation of the system which supplies conditioned air to this entire general office building

*Carrier Engineering Corporation, Philadelphia, Pa.

[1] Architects: Howe & Lescaze. General Contractor: George A. Fuller Co.

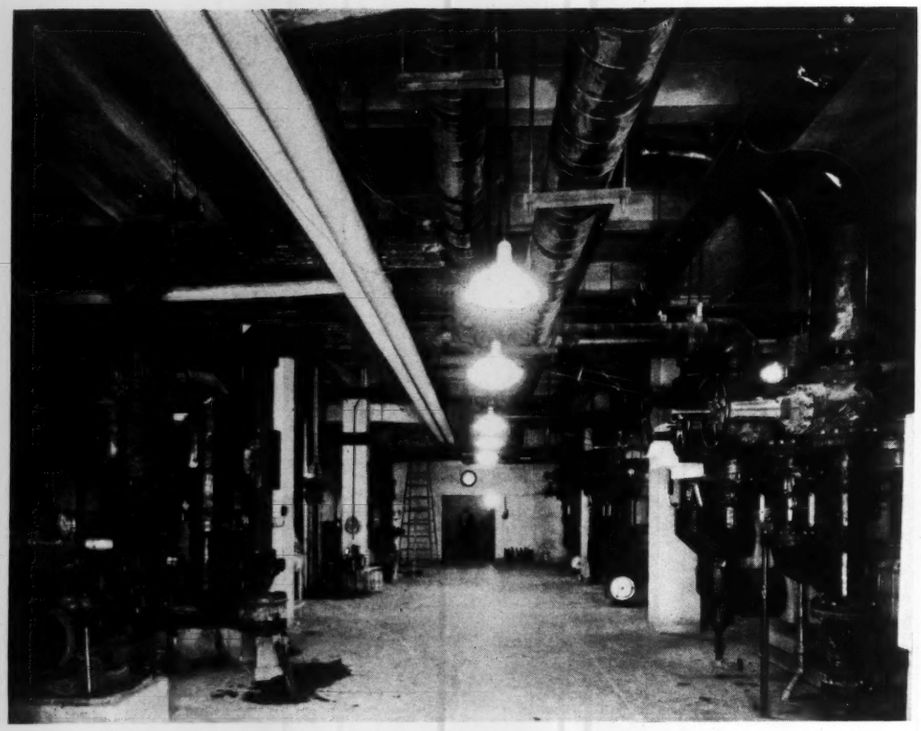


Fig. 3—Construction view of the refrigeration room; the cold-water and cooling-tower pumps are shown at the left

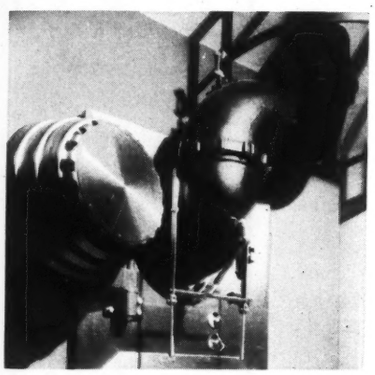


Fig. 4—Detail of the air-supply connection to the vault. At night, the short duct is rolled back, the vault door closed, the vault protected

These office floors (Floors 6 to 31 inclusive, except the 20th) presented a difficult problem. Individual room thermostats would result in a hopelessly cumbersome system; also, the operator would find it difficult to secure access to the offices, assuming he found it possible to make so many adjustments. Since it would not be desirable to depend upon the tenants of the offices for adjustment of individual thermostats, the problem resolved itself into that of centralizing the entire control. The base cooling load of the floors (consisting of people, lights, wall transmission and infiltration) is virtually constant during the day. The major variable is sunlight, which imposes a severe and changing load on the building as the sun moves from east to west. With the problem so reduced, a careful study was made of the sun and shade effects on the building and the upper floors were divided into three zones.

The first zone embraces Floors 6 to 12; the second, Floors 13 to 19; the remaining zone includes Floors 21 to 31. The advantage of subdividing the twenty-five office floors in this manner lay in the fact that all floors having the same amount and intensity of exposure are grouped, which makes accurate control of an even temperature from a central control feasible.

On *one* floor of each zone a thermostat in the return air controls a damper on *each* floor of the zone, regulating the amount of conditioned air supplied to the mixing plenums of the floor fans and fixing the average

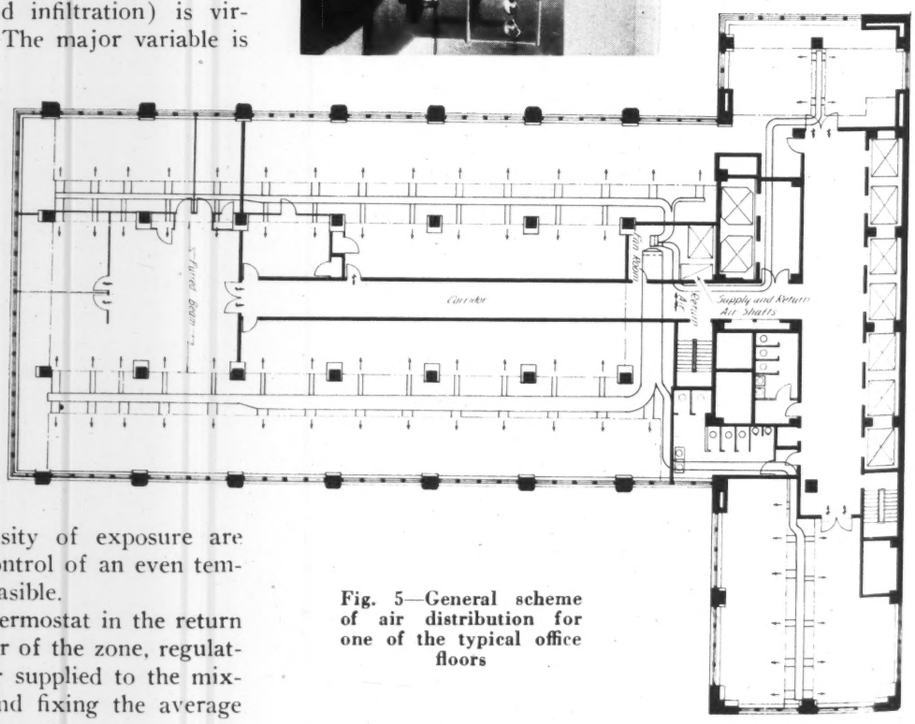



Fig. 5—General scheme of air distribution for one of the typical office floors

Table 1—Inside Conditions with Various Dry- and Wet-Bulb Temperatures

| Outside Temperature, F | | Inside Conditions | |
|---|---|---|---|
| Dry Bulb | Wet Bulb | Dry Bulb, F | Relative Humidity, % |
| 95 | 78 | 80 | 42 |
| 90 | 77 | 78 | 45 |
| 85 | 75 | 76½ | 47 |
| 80 | 74 | 75 | 50 |
| 75 | 70 | 73 | 53 |
| 70 | 60 | 72 | 55 |
| .. | 50–55 | 70 | 60 |

temperature of each floor at the same level. The control piping is so arranged that this thermostat may be placed on any floor in the zone. The effectiveness of the control is thus unimpaired if the majority of the floors are unoccupied and the booster fans are not operating.

Having fixed the average temperature of each floor in the zone, it was necessary to provide some means of automatically shifting the cooling effect of the conditioned air from the east to the west fans as the sun progressed during the day. This problem was solved by the use of a differential thermostat in each zone. This thermostat is governed by the temperatures in typical offices on each exposure and is adjusted to maintain these temperatures at the same level. Any differential in temperature between the two exposures causes the thermostat to change the position of the conditioned-air dampers in the suctions of the east and west fans through the zone. By means of these inter-connected dampers on each floor, the conditioned air supplied to the floor as a whole is proportioned to meet the demands of the two exposures of the floor. Since these three differential thermostats require no adjustment after the initial setting, the temperature of the entire twenty-five floors may be raised or lowered as desired by the adjustment of the three graduated-acting zone thermostats.

These upper floors are handled by two central dehumidifying plants on the 20th floor—one serving the 6th to the 19th floors, the other the 21st to the 33rd floors.[2] From each of the two fans on this floor, a supply- and return-air shaft extends through the zone handled. Two recirculating fans on each typical office floor draw conditioned air from these shafts and mix it with return air from the floor to secure the proper delivery temperature to meet the load demand. The orientation and design of these floors are such that the east and west exposures are the only two that require independent systems to hold conditions with the movement of the sun during the day. With one of these recirculating fans handling the east load and the other the west, it has been found relatively easy to hold constant conditions regardless of the position of the sun.

## Special Outlets Handle Low-Temperature Air

In designing a system to meet all possible schemes of locating partitions on the office floors, it was decided to provide two outlets for each bay. These outlets were developed to meet the exacting demands of the distribution system for these offices. Since it was assumed that the occupants of the offices would be seated while at work, and that some of the offices would be quite small, it was necessary to design an outlet that would distribute the air with a minimum movement in the room. Further, it was obvious that the outlet must incorporate some means of adjustment to meet varying loads with widely differing occupancy.

After extensive tests, an outlet was adopted that consists essentially of a flat plate provided with horizontal slots so fashioned that each forms a round-edge orifice, noiseless at the 2000-fpm velocity employed. It was found that these outlets are well-adapted to the handling of 50-F low-temperature air without causing drafts. Supplying air at temperatures lower than have previously been considered good practice for overhead distribution results, of course, in relatively small ducts with a saving in the cost of installation, in the amount of space required, and in the power required to move this reduced air quantity.

Fig. 5 shows the general scheme of distribution for one of these twenty-five typical office floors. The return air from the floor is drawn through the corridors, louvres being provided in all doors. A louvred grille is installed in the wall of the fan room. A portion of the air returned is drawn back to the central equipment on the 20th floor, and the remainder is available for mixing with the conditioned air as previously described.

No exhaust was provided for the office floors, since it is desirable to keep a pressure on the conditioned space. The stack effect of the cold air in a building of this height would induce excessive infiltration on the upper floors unless the supply air exceeded that returned to the apparatus. The excess is represented by the amount of the outside air supplied, which leaks out through windows and elevator shafts, and is exhausted through toilet rooms.

On the 32nd floor (which contains the board room, committee room, lounges and dining rooms for officers and employes of the bank) the widely varying occupancy of the space and the intermittent operation necessitated separate supply fans for virtually all of the rooms. These fans supply a mixture of conditioned air and bypassed air to the spaces, the proper balance being maintained by mixing dampers controlled by room thermostats.

## Evaporative Cooling Conserves Refrigeration Power

A number of other interesting features are incorporated in this office building air-conditioning system.

The basement, the five lower floors and the mezzanines[3] are each served by a complete system consisting of a dehumidifier, fan, recirculating pump, heaters of the extended surface type, and oil filters designed to handle the full capacity of the fan. The two sets of equipment for the basement and first floor are located in the sub-basement, while the remaining five are installed between the trusses on the third mezzanine. Outside air for these seven dehumidifiers is taken through the roof at the third-floor set-back.

[2] The 33rd floor has a single large office occupying the southeast wing.

[3] A restaurant and shops will occupy the basement and first floor, it is expected. The second floor, and the first, second, and third mezzanines are devoted to the public space and offices of the Bank. The third, fourth and fifth floors are open to public tenancy.

An outboard exhaust is provided for these lower floors. To conserve refrigeration power, the dehumidifiers were selected to take advantage of evaporative cooling during certain periods of the spring and autumn by passing virtually the entire fan capacity of outside air through the sprays. When this condition exists, the exhaust fan on the 33rd floor will exhaust through the ducts which are normally used for the return air. Automatic louvre dampers in the exhaust connections are linked in series with the outside-air dampers, preserving the balance between outside-air supply and exhaust.

The distribution for these lower floors is by means of narrow slots incorporated in the concealed lighting fixtures, and by baffles made integral with the suspended lights. Since the tenancy of the 3rd, 4th, and 5th floors was not known in advance, air is supplied at the ceiling around each light. A booster fan is also installed for both the north- and east-wall outlets on each of the three floors. These two walls embody large exposures of glass so that the character of the load in an outside office differs greatly from that of an interior office with no exposure. With this complete scheme of distribution, the system is flexible enough to insure that, regardless of the divisions of the space, each office receives its quota of air, properly controlled.

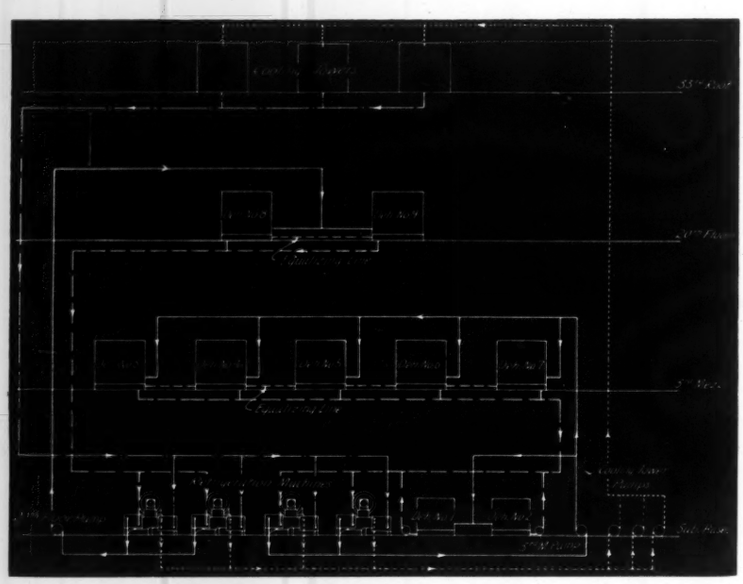


**Fig. 6—Diagram of the cold-water piping layout**

### Synchronous Motors, Cut-out Couplings, Correct Power Factor

The refrigeration for the air-conditioning system consists of four centrifugal machines, rated at 985 tons total, gear-driven by two synchronous and two variable-speed motors. There are two machines serving the first five floors and the basement, each driven by a 300-hp motor. The two machines handling the upper typical office floors are driven by 400-hp motors. One of each pair of motors is synchronous, the other variable speed. The synchronous motors are equipped with cutout couplings, so that each or both may be run idle for power-factor correction.

The layout of the cold-water piping (Fig. 6) from the two refrigeration machines to the apparatus on the third mezzanine was planned for a balanced head, so that the pump operates against a pressure which is the sum of the pipe and cooler friction and the head on the nozzles. Since the two dehumidifiers located in the sub-basement are supplied by the same system that serves those on the third mezzanine, the recirculating pumps on the two lower sets of equipment were designed to pump the return from the tanks into the return lines. Balanced float valves are installed in the pump suctions to hold the level in the tanks and safety relays are provided in the nozzle supply so that the dehumidifier draws water from the system only when the pump is operating and returning into the main. The necessary head on the nozzles is supplied by the static head on the entire supply system. The main circulating pump is located in the supply line beyond the spray header connections to these two dehumidifiers, and handles all of the water for the third mezzanine.

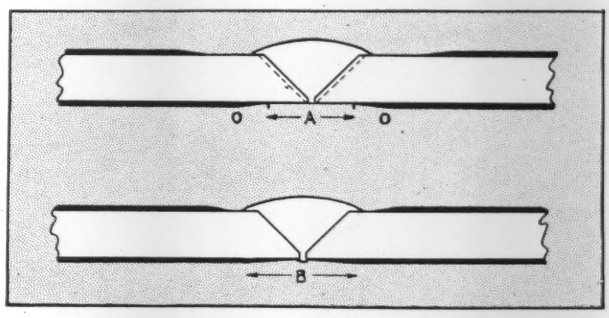
Since the five dehumidifiers on the third mezzanine are located directly above the banking space, every precaution was taken to guard against the possibility of a flood. For this reason, there are no valves in the separate returns from the dehumidifiers to the common return line. To guard against any unbalanced condition in the return line, an equalizing line was installed with a connection to each dehumidifier. The cold water for the two sets of equipment on the 20th floor is handled in a like manner.

**Fig. 7—A cooling tower assures uninterrupted service of the refrigeration machines during possible periods of low city-main pressures. It is of the forced-draft type, designed to cool 3,800 gpm from 98 to 90 F under the most severe conditions**

# Welding Galvanized Piping*

EXPERIENCE indicates that welding galvanized pipe, whether iron or steel, does not affect the corrosion resistance or strength of the pipe itself, and the question of the use of either steel welding rod or bronze welding rod is not therefore a serious consideration when endeavoring to determine the best type of joint.

Both steel welding and bronze-welding of galvanized piping have been practiced for many years, and to date there has been no evidence or complaint of accelerated corrosion at the joint as the result of welding. The whole facts and conclusive deductions will probably not be established in the lifetime of any living investigator or in the span of years of any engineer or person concerned with this subject, as obsolescence and replacement practically always are more important factors than the life of the welded joint or piping system. However, sufficient experience and consideration of practical facts point to one conservative conclusion; namely, that with the exception of piping exposed to highly corrosive mediums, as dilute acid or alkaline solutions, no appreciable accelerated corrosion will occur at the joint as compared to the rest of the pipe when welded either with steel or bronze welding rod; or whether galvanized or ungalvanized.




**Above—Cross-section of wall of galvanized pipe showing a fusion weld. Below—Cross-section of wall of galvanized pipe showing bronze-weld**

### Electrolysis and Galvanic Corrosion

Unfortunately the phenomenon of *electrolysis* is occasionally confused in a consideration of the welding of galvanized steel pipe, particularly bronze-welding. Electrolysis is generally considered as corrosion resulting from stray currents, and shows itself principally as excessive deterioration where the current leaves the pipe. Welding is not a factor except that it improves the condition at the individual joints because the welded joint is an excellent conductor, localizing the corrosive effect only at the point where the current ultimately leaves the line which may not be a joint. Corrective methods for this are by grounding the pipe, a method well established through experience, or the more costly method of trial and error.

On the other hand, *galvanic* corrosion, resulting from potential difference of dissimilar metals, has been the principal factor to cause prejudice against the use of bronze-welding. Off-hand consideration of this effect would at first glance point to corrosion at the joint, where dissimilar metals such as a bronze-welded joint on steel or cast iron are used, but experience establishes the fact that accelerated corrosion does not occur. This has led, in recent years, to eminent authorities on the subject of corrosion altering their conception and theory of this phenomenon. A few common experiences may be briefly reviewed as follows:

*1.* Examination of the battleship *Maine,* containing as it did numerous examples of contact of non-ferrous metals with cast iron and steel and subject for years to salt water action, showed no evidence of accelerated corrosion of these points of contact.

*2.* Bronze-welded cast-iron and steel pipe has been used for years subject to both external soil and internal corrosion and has led to no complaint of deterioration of the joint. In the case of cast iron, many lines have been laid in various sections of the country, in service for over 8 to 9 years, in which the bronze-welded joints have shown no signs of corrosion.

*3.* A large company that has been manufacturing acetylene generating units for house lighting for many years, has been using bronze-welding for joining galvanized steel shells. These literally thousands of units are buried throughout the country under varying conditions, subject internally to water of varying corrosive intensity and soil conditions externally. No complaints have ever been received to warrant any change in the method of construction.

*4.* Brass valves and corporation cocks have been used by gas distribution companies for two generations for service connections to gas mains. Also many such companies have used bronze-welding because of its lower temperature in making service connections to live gas mains. The experience of these companies, which necessarily are concerned vitally with this matter of corrosion, has never led them to change their practices.

*5.* Brass and bronze seats and parts in valves and other fittings, brass and copper tubing in cast-iron and steel condensers, as well as other examples in innumerable kinds of mechanical equipment, conclusively illustrate that contacts of dissimilar metals do not cause serious corrosion.

*6.* Research by members of the *American Petroleum Institute* and the *American Gas Association,* in which bronze-welded examples of ferrous metals have been buried throughout the country, has shown no evidence of deterioration because of the dissimilar metals.

(*To page 78, back Advertising Section*)

*Abstracted from a paper prepared by welding engineers of The Linde Air Products Company, New York City.

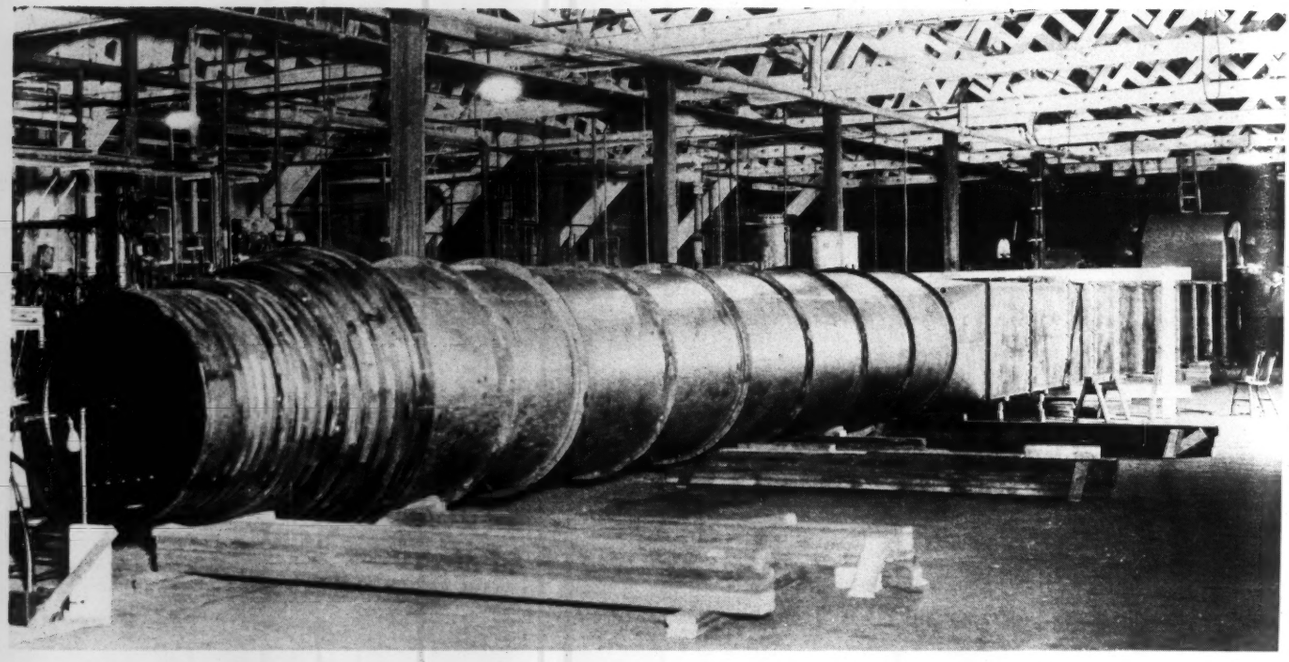


Fig. 1—Duct for the flow-nozzle method of test for the Boston traffic tunnel 48-in. fan at Harvard University

# Testing the Fans for the East Boston Traffic Tunnel

***THOROUGH** were the specifications the ventilating fans for the new East Boston traffic tunnel had to meet. In vehicular tunnels (of which the East Boston tube is the fourth to be constructed in the United States) ventilation is, needless to say, a major consideration . . . . . How the fans (which are now being installed and which will supply a maximum of 1,000,000 cfm of fresh air to this tunnel) were tested is told here.*

SPECIFICATIONS for the twenty-eight fans (four are spares) now being installed in the new East Boston traffic tunnel[1] are of interest to ventilating engineers because of their completeness, as is the manner in which the fans were tested. The specified operating conditions are shown in Table 1.

As 7 fans are connected to one main duct, it is necessary that these fans have characteristics which will per-

[1]The East Boston traffic tunnel, fourth vehicular tunnel to be built in this country, is expected to be opened to traffic early in 1934. Connecting Boston with East Boston and running under the harbor, the tunnel will form an important traffic link connecting the city with the thickly-populated north shore and the main highways leading to the northern New England states. Length of the tube between portals is 5,650 ft, outside diameter of the casing is 31 ft and height from crown of roadway to ceiling is 13½ ft.

The roadway provides for two lanes of traffic, one in each direction; two large ventilation buildings, one at each side of the harbor, house the fans for the tunnel ventilation. Each building has 14 fans, 7 blowers and 7 exhausters, with one fan in each set reserved as a spare. The maximum amount of fresh air which may be supplied is slightly over 1,000,000 cfm, changing the entire volume of roadway air 40 times per hour.

Fresh air is supplied throughout the length of the tunnel from longitudinal slots above the roadway at automobile hubcap level; vitiated air is removed vertically through outlets in the ceiling. The fresh air is delivered to the supply ducts under the roadway by the blower fans. This air is taken off at intervals of 15 ft on both sides of the duct and conveyed through short flues provided with dampers into continuous chambers located above the curb on both sides of the roadway. These chambers are provided with continuous adjustable slots which allow regulation of air velocity entering the roadway.

The foul air is removed through adjustable rectangular ports located in the ceiling slab. Through these ports the air passes to the exhaust duct and is drawn through and discharged to atmosphere by the exhaust fans. Each air duct section of the tunnel connects to the ventilating shafts and terminates in the ventilation buildings in 7 ducts, each of which is connected to one fan.

[ By J. E. Gill* ]

mit successful operation in parallel. Total pressures specified were based on resistance when all 6 fans are operating at the same time. Inasmuch as all fans on one duct will not be continuously operated, preference was shown for fans having high efficiency and large volume at low pressure, with non-overloading horsepower characteristics.

The specifications incorporated a provision not heretofore used on jobs of this nature. Prior to the award of the fan contract a test (by dis-interested engineers) of a smaller but geometrically-similar fan was required to verify the curves submitted with the bid. These guaranteed curves of the full-sized fans were thus to be checked by stepping up the performance of this smaller fan according to the ratio of wheel diameters and speeds.

Tests were also called for on a full-sized fan of each size and type at the manufacturer's plant before any shipments were made. All tests were to be in accordance with the standard test code of the *American Society of Heating and Ventilating Engineers*. In addition to the standard pitot test, two points in the operating range were to be run on the small fan using the flow nozzle method of test. Operating range was considered to be from 30 per cent to 85 per cent of wide-open volume. Test horsepowers were to be within 3 per cent of guaranteed values in this range and within 5 per cent throughout the rest of the range.

Specifications for the drives called for 28 two-speed, two-winding, squirrel-cage motors for operation on 440-volt, 3-phase, 60-cycle current. Motors are direct-connected to fans by flexible couplings; synchronous speeds of the motors are 450 and 225 rpm. Horsepower ratings of the motors were specified as 50 and 6.25 hp respectively. Motor and control bids were submitted directly to the transit commission by the electrical manufacturers.

To meet the specifications, 28 fans with the same size housings, wheels, shafts and bearings (with fixed inlet vanes or guards to turn the entering air in the same direction as the rotating fan wheel to decrease shock losses, aid efficiency and give a non-overloading horsepower characteristic) were selected. By utilizing different angles of these fixed vanes with respect to the rotor, different characteristic curves can be obtained from the same fan housing and wheel. Thus it was possible to use 28 duplicate fans and by using two different vane angles, meet the different ratings called for in the specifications at approximately the same full-load motor speed. All blowers thus had the same inlet-vane angle and the difference in ratings between Boston and East Boston blowers caused a small variation in rated speeds. The exhausters had a different vane angle and the same slight variation in rated speed was necessary.

Table 2 shows the guaranteed speeds and horsepowers. Only the values at the specified rating points are shown although the complete range was guaranteed by the performance curves submitted with the bid. A column of *limit horsepowers* shows the maximum horsepower the fan can take at the rated speed under any conditions of capacity or pressure.

*Engineering Department, Buffalo Forge Co., Buffalo, N. Y.

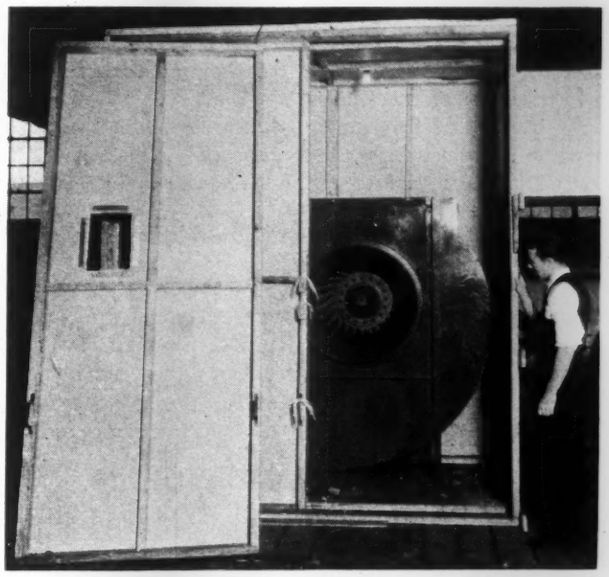


Fig. 2—Fan installed in model tunnel room for testing

## Small Geometrically-Similar Fan Tested

In accordance with the specifications, a geometrically-similar fan of smaller dimensions was submitted for test in order to verify the guaranteed curves. A fan with a rotor diameter of 48 in. corresponding to the actual full-size rotor diameter of 69¾ in. was set up in the Gordon McKay laboratory of the Harvard engineering school. One housing, wheel and shaft assembly was supplied and two sets of inlet vanes, so that the fan could be tested as blower and exhauster. Prof. C. Harold Berry of the school conducted the test assisted by a crew of nine observers from the engineering department of the Boston transit commission.

Precautions were taken to insure high test accuracy. All instruments or gages liable to errors whose ef-

Table 1—Specified Operating Conditions

| Fans | Total No. of Fans | No. of Fans Used for Full Load | Total Quantity C F M | Quantity of Each Fan C F M | Total Pressure at Fan, Inches of Water | Density, Lb per Cu Ft |
|---|---|---|---|---|---|---|
| Boston Blower | 7 | 6 | 558,000 | 93,000 | 2.20 | 0.08 |
| Boston Exhauster | 7 | 6 | 570,000 | 95,000 | 2.50 | 0.0784 |
| East Boston Blower | 7 | 6 | 537,000 | 89,500 | 2.25 | 0.08 |
| East Boston Exhauster | 7 | 6 | 549,000 | 91,500 | 2.70 | 0.0784 |

Table 2—Guarantee at Operating Points

| Fans | Capacity, C F M | Total Pressure, In. | R P M | Brake H P | Limit H P | Density, Lb per Cu Ft |
|---|---|---|---|---|---|---|
| Boston Blower | 93,000 | 2.20 | 433 | 43.0 | 44.6 | 0.08 |
| Boston Exhauster | 95,000 | 2.50 | 435 | 48.0 | 48.8 | 0.0784 |
| East Boston Blower | 89,500 | 2.25 | 427 | 41.4 | 42.6 | 0.08 |
| East Boston Exhauster | 91,500 | 2.70 | 436 | 48.8 | 49.2 | 0.0784 |

fect upon the results would be significant were calibrated several times. Computations from observed data were made by the engineering staff of the transit department and were double checked.

The results of this test on the small fan, adjusted in the ratio of wheel diameters and speeds to correspond to the full size fan, are listed in Table 3.

### Two Points Checked with Flow-Nozzle Method

The flow-nozzle method of test was used to check two points within the operating range. Two Moss[1] nozzles having diameters of 30 and 40 in. and giving capacities of approximately 55 per cent and 83 per cent of free delivery volume were attached to the duct and tested. A simultaneous pitot-tube traverse was taken so that the results by both methods of test could be compared. The nozzle test results checked the *A. S. H. V. E.* standard test, falling well within the 3 per cent allowance. Two tests on the 30-in. nozzle varied about ½ of 1 per cent in air and pressure from the pitot test, while the 40-in. nozzle differed by approximately 2½ per cent—one test being high and the other low. The horsepower in both cases checked closely the curve established by the standard method of test.

### First Full-Size Fan Tested

The first of the full-size fans completed was erected for test in the manufacturer's laboratory in accordance with specifications, and Professor Berry, with a test crew from the Boston transit department, again ran a complete test making all observations and calculations. The same degree of accuracy used on the test of the smaller fan at the Harvard laboratory was obtained by means of repeated calibrations of all instruments and extreme care used in observing and recording data and calculating results.

Test results on the full-size fan are shown in Table 4.

The test figures show that in each case the fan met or bettered the guaranteed performance. It will be noted that in all cases the pressures equal or exceed those specified and that the test horsepowers in all but one case were less than guaranteed. The Boston exhauster horsepower was 2/10 of 1 per cent above that guaranteed but this increase in horsepower was accompanied by an increase in pressure of 1.6 per cent.

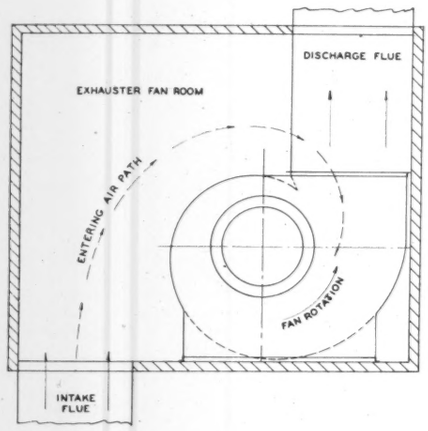



**Fig. 3—Typical exhauster fan room, indicating how direction of air flow may be such as to make the fans require excessive horsepower**

### Exhaust-Fan Room Tested

Particular importance was placed by the engineers on the requirement of the specifications that the fans were not to overload motors under actual installation conditions. In many conventional installations the fact that the fans on block test consume, at the peak of the horsepower curve, less than the horsepower rating of the motors, would automatically insure no overload of the motors when installed. However, on tunnel-ventilation installations it has been found that the exhaust fans frequently absorb more horse-power than indicated on block test.

These exhaust fans are usually installed in small rooms or plenum chambers and the structural limitations of the ventilation buildings frequently necessitate the location of the intake and discharge flues in such a position that the necessary fan rotation is opposite to the air rotation within the fan room, as induced by the location of the inlet opening. This necessitates a reversal in the direction of flow as the air approaches the fan inlet or inlets, and causes a disturbed condition which has in some cases resulted in fans requiring excessive horsepower without any increase in air delivery. Fig. 3 shows a typical arrangement of an exhaust fan in a small chamber with inlet and discharge openings which cause reverse flow.

To insure the fulfilment of the above items in the specifications, a replica of one of the exhaust fan rooms and apparatus was constructed on a small scale. One side of the room was removable so that the fan could be run with unobstructed inlet conditions. Complete pitot-tube tests were run to determine the performance curves of the fan under actual installation conditions, and showed that the fans could not exceed their test peak horsepower even when operating with bad inlet conditions.

**Table 3—Test Results of Small-Size Fan Adjusted to Full-Size Fan[a]**

| Fans | Capacity, C F M | Total Pressure, In. | R P M | Brake H P | Limit H P | Density, Lb per Cu Ft |
|---|---|---|---|---|---|---|
| Boston Blower | 93,000 | 2.22 | 433 | 41.9 | 45.0 | 0.08 |
| Boston Exhauster | 95,000 | 2.52 | 435 | 48.8 | 49.2 | 0.0784 |
| East Boston Blower | 89,500 | 2.28 | 427 | 40.7 | 43.0 | 0.08 |
| East Boston Exhauster | 91,500 | 2.70 | 436 | 49.5 | 49.8 | 0.0784 |

[a]Values taken from test curves prepared by Prof. Berry.

**Table 4—Test Results of Full-Size Fan[a]**

| Fans | Capacity, C F M | Total Pressure, In. | R P M | Brake H P | Limit H P | Density Lb per Cu Ft |
|---|---|---|---|---|---|---|
| Boston Blower | 93,000 | 2.21 | 433 | 41.7 | 44.4 | 0.08 |
| Boston Exhauster | 95,000 | 2.54 | 435 | 48.1 | 48.7 | 0.0784 |
| East Boston Blower | 89,500 | 2.26 | 427 | 40.2 | 42.5 | 0.08 |
| East Boston Exhauster | 91,500 | 2.70 | 436 | 48.7 | 49.1 | 0.0784 |

[a]Values taken from test curves prepared by Prof. Berry.

[1]Method of test and design of nozzle followed very closely that outlined by Dr. Sanford A. Moss in his paper "The Impact Tube," published in the *Transactions of the American Society of Mechanical Engineers*, Vol 38, p. 761

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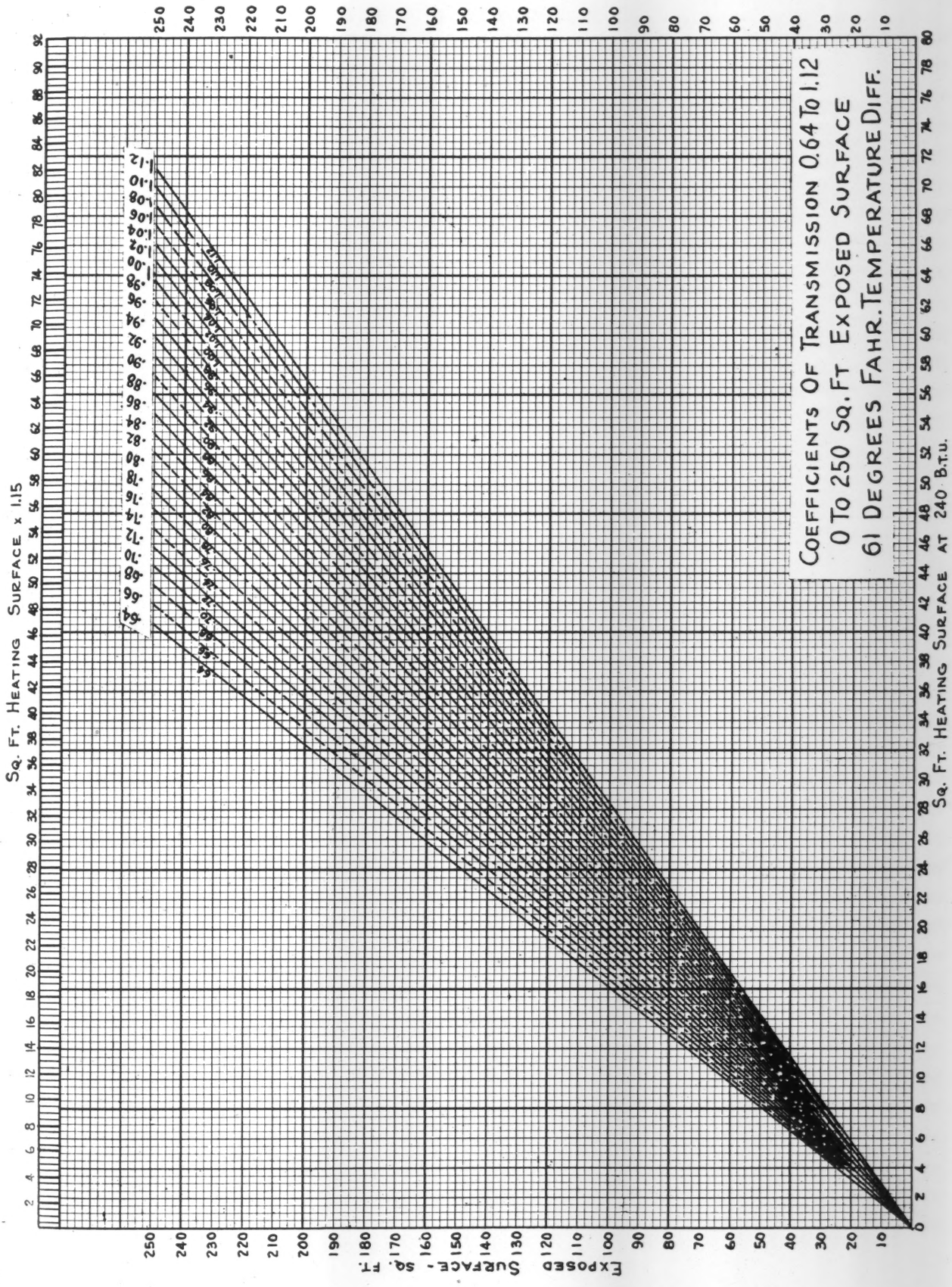
A complete report of the Bureau of Standard's study of the deterioration of book papers in libraries is given in the Bureau Miscellaneous Publication No. 140 (Superintendent of Documents, Washington, 5c). Air polluted by sulphur dioxide probably explains the greater deterioration of books stored where the atmosphere is characteristically urban, it is concluded.

# Calculating Heating Surface for Buildings . . . . . 5

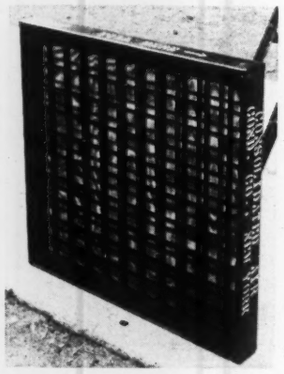
. . . . by Price L. Rogers, Consulting Engineer, Philadelphia, Pa. This is Chart No. 5 of a series designed to enable computations for heat losses from buildings to be made accurately, with a minimum of time and with decreased possibility of errors. Chart No. 1 and an explanation of the series and its use was published in April; Chart No. 2, May; Chart No. 3, June; Chart No. 4, last month.


Coefficients Of Transmission 0.64 To 1.12
0 To 250 Sq. Ft Exposed Surface
61 Degrees Fahr. Temperature Diff.
Sq. Ft. Heating Surface x 1.15
Sq. Ft. Heating Surface at 240 B.T.U.
Exposed Surface - Sq. Ft.

# *INTERESTING* Equipment..... Developments

## New Filter Designed to Remove Odors

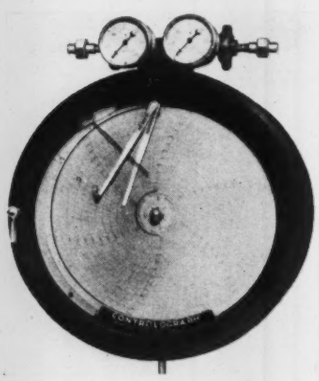
The Consolidated Air Conditioning Corp., 192 Lexington Ave., New York City, has recently developed an odor filter utilizing activated cocoanut-shell carbon. Extensive tests were made of this method of removing odors, according to the makers, and many applications in connection with ventilation and air conditioning are expected. Among these are the removal of odors from recirculated air to allow recirculation of larger percentages, removing odors from outside air, removing odors from air in industrial plants to prevent contamination of products, and removing odors from air discharged from plants to the atmosphere. Special applications such as converting to recirculation systems now using 100 per cent outside air and removing odors from air in confined spaces to which it is impracticable to introduce new air are also mentioned in the bulletin which describes this odor filter.



The principle of operation involves the absorption of condensable gases and vapors, similar to the principle employed in gas masks during the war.

Unit cells, one of which is shown here, hold the carbon bed, and are 20x20x2¼ in. Air-handling capacity is 125 cfm at a face velocity of 54 fpm, static resistance, 0.5 in. water gage. Weight per cell is approximately 29 lb. The standard cabinet holds four cells, is 20¼x23x23 in. overall; weight with cells is about 175 lb.

## Controls, Records Process Temperatures



A "controlograph" for use in the process industries, air conditioning, etc., where close control of temperature is important has recently been made available by the American Schaeffer & Budenberg Division of the Consolidated Ashcroft Hancock Company, Bridgeport, Conn. It records the exact temperature being controlled, in addition to controlling it.

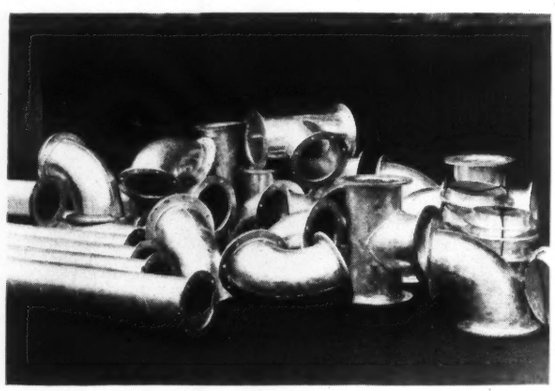
The operating range is from minus 40 F to plus 1000 F. The kind of control is at the will of the operator—on and off or throttling. (Instruments for pressure control 15 to 600 lb and 601 to 1000 lb, are also available.)

A single thermostatic system operates both controlling and recording movements. A change in temperature actuates the thermostatic system which, in turn, actuates an air valve to close, open, or throttle a diaphragm motor valve, direct acting or reverse acting. Air at 15 lb pressure is used.

This controller is actuated by mercury or vapor tension, the former being recommended for short lines. Standard clock is spring wound; electric-type clock if preferred. The case is moisture-, fume-, and dust proof, finished in black duco. A 10-in. chart with an effective scale length of 3⅝ in. is standard.

## Light-Weight Welding Fittings Available

A new line of light-weight steel welding fittings for light-wall and spiral pipe is now being manufactured by Taylor Forge & Pipe Works, P. O. Box 485, Chicago. No. 10 gage (0.134 in.) steel is used. They are suitable for hydraulic pressures of 200 lb per sq in., more on the smaller sizes, and are tested to 50 per cent in excess of the working pressure for which they are ordered.



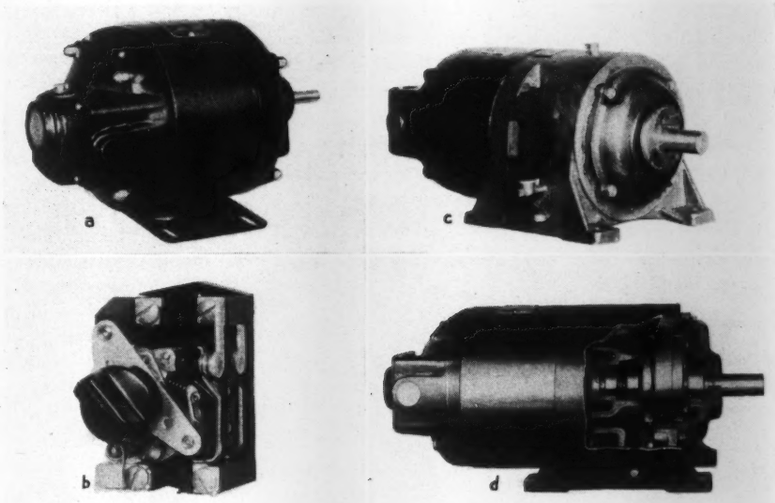
Center-to end dimensions conform to the 125-lb American Standard; they are furnished plain end or flanged, or flanged one end only. Features stressed by the maker include smooth, workmanlike appearance and minimum resistance to flow due to die-forming, strength, ease in handling, and the saving in weight.

## Several Motor Developments

A new single-phase, fractional horsepower motor, specially designed for driving small water pumps, has been developed by the General Electric Company, Schenectady, N. Y. Among the features are drip-proof end flanges to prevent dripping water from entering the motor, a large bearing-oil capacity which makes oiling of the motor unnecessary more than once a year, and a built-in terminal box for simplifying installation by eliminating all necessity for splicing and soldering connections. The performance characteristics of the motor are in accordance with *N. E. M. A.* standards for short annual service. The motor is available in ⅙, ¼, and ⅓ hp ratings, with interchangeable mounting dimensions.

In addition to water pump service, this motor is adaptable to such applications as beer pumps, oil and grease pumps in service stations, certain types of circulating pumps, and other devices requiring similar load characteristics.

Also recently announced by G. E. is a line of fractional horsepower gear-motors with the characteristics and construction of the latest designs of general-purpose motors. They combine the features of light weight, efficient high-speed motor drive with a compact reduction gear to give almost any desired speed at the output shaft. Connections to driven machines may be made directly or through the use of gears, belts, or chains. Full access to the gear mechanism is possible by removal of the cover plate. Large oil capacity and a complete lubrication system are designed to assure long life without frequent attention.




These motors are available in two types, both in ratings from 1/6 to 3/4 hp inclusive; the concentric shaft type, with speeds from 500 to 98 rpm, and the right-angle shaft type, with speeds from 200 down to 11 rpm.

The fractional horsepower gear-motors utilize the planetary type of gearing with concentric shafts in the smaller ratios and worm gears single or in combination with the planetary type in the higher ratios.

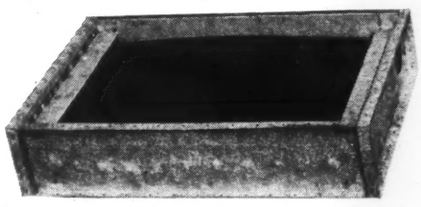
Yet another "motor development" announced by this company is a small, hand-operated starting switch, for providing complete protection against stalled-motor current and injurious overload conditions, for use with either single-phase a-c or d-c fractional horsepower motors. The a-c switch is available in single and double-pole forms. The new switch affords the following features, according to the maker: complete overload protection, positive snap-action mechanism trip-free on overload, sturdy and compact construction, and adaptability for mounting in purchasers' enclosures. All molded parts are made from textolite and the large contact tips are pure silver. The metal parts will resist corrosion. The switch has been tested and listed by the Underwriters' Laboratories.

To facilitate installation, the switch has been made available in several forms, as follows: open-type switches for applications where the purchaser wishes to provide his own enclosure; enclosed-type switches for general purpose applications; and switches for *Class I, Group D* hazardous locations. The open-type switch (illustrated) is the basic form.

In the illustration *a* shows the water-pump motor; *b*, an a-c open-type double-pole switch with hand knob; *c*, concentric shaft gear motor; and *d*, cut-away view of right angle type gear-motor.

## Develops New Blast Heaters

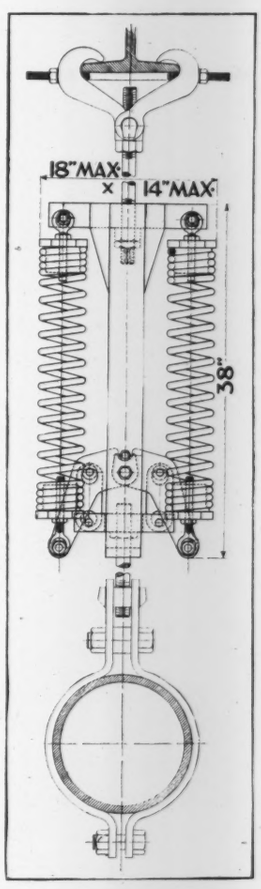
The Young Radiator Co., Racine, Wis., has recently developed a new complete line of blast heaters; a feature is a new type of header, cast in electric furnace iron and designed to distribute the steam through the tubes evenly. These tubes are bowed in a gentle curve to care for expansion and contraction and eliminate strains resulting from high temperatures and pressures. Bond of the tubes to the head is reinforced by ferrules which serve as orifices in the supply end. On the return end the tubes are spun out and ferruled, the inside diameter of the ferrule being the same as that of the tube, affording a free discharge of condensate whether the core is installed vertically or horizontally. The tubes and fins are fused together by a patented process.



This line includes 45 different sizes to meet any requirements in construction. The units are also designed and furnished for high pressure, tested and guaranteed. They may also be used for cooling purposes in connection with air-conditioning equipment when water or brine is used as the cooling medium.

## Pipe Hanger Prevents Non-Axial Forces

A constant-support pipe hanger designed to prevent the occurrence of the non-axial forces which cause failure of joints in high temperature piping systems has been developed by the General Spring Corporation, 11 W. 42nd St., New York City. The constant support feature is achieved by supporting the weight of the pipe not directly on the springs in the ordinary manner, but through levers which compensate for the changes in the supporting effort of the springs as they are deflected by vertical movements of the pipe line. The hanger weight of approximately 160 lb to support loads of from 500 to 7000 lb, is another feature which is stressed by the manufacturer. The hanger will accommodate vertical movements up to 2 in.,

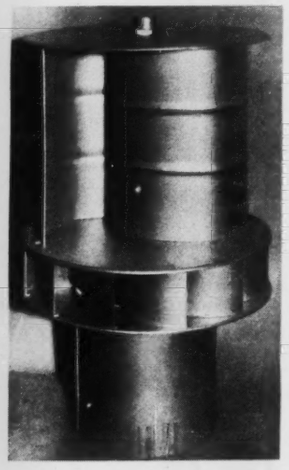


ranges greater than this being provided on special order.

The load capacity range mentioned above is based on 12-ft suspension intervals, for pipes 8-in. diameter empty and without fittings to 20-in. diameter full of water with an additional 100 per cent allowed for fittings. Wide range of rated capacities is permitted by the use of interchangeable springs of different capacities which at any time may be adjusted to plus or minus 15 per cent of their rated capacity.

Maximum over-all height is 38 in.; width, 18 in.; thickness, 14 in. Hangar and pipe rods are ⅞, 1, 1¼ in. All threads are U. S. standard pipe.

## Introduces Rotor-Type Ventilators

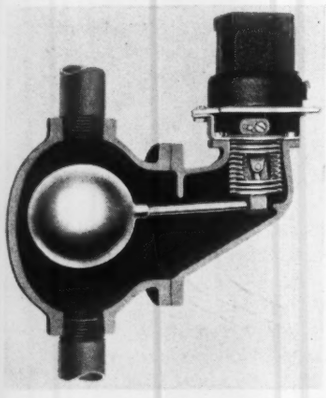


The United States Ventilator and Power Corporation, 184 Summer St., Boston, Mass., has recently introduced to this country a line of rotor-type ventilators and smoke cowls which are a combination of the Savonius wind rotor and a special type of centrifugal fan. They are constructed of non-corrosive materials and run on ball bearings so lubricated as to require no maintenance attention.

Sizes are 6, 8, 12, 20, 30, and 40 in. With a wind velocity of 4 mph, the suction capacity (in cu ft of air per hr with no stack velocity added) for the 6-in. size is 3200, for the 40-in. size 122000, says the manufacturer. With a wind velocity of 8 mph, the corresponding figures are 7000 cfh and 253000 cfh.

Rotor ventilators of similar type are also made for marine applications.

## Low-Water Cut-Off for Boilers



A new low-water cut-off has just been placed in production by McDonnell & Miller, Wrigley Bldg., Chicago, in four types—with automatic reset, manual reset, high-voltage alarm and automatic reset, and high voltage alarm and manual reset. It is for use with boilers of any size, maximum steam pressure of 25 lb, according to the manufacturers.

The entire float and lever unit moves as one unit on a single bearing outside the steam and water zone. The switch chamber and important working parts are sealed from the float chamber by a sylphon bellows, hence there is no stuffing box. Limit stops prevent the float from over-riding. The switch has a quick make and break, to prevent arcing and burning, and a wiping action to keep contact points bright.

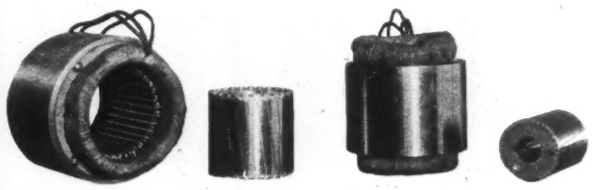
## Develops 2-in. Indicating Gage

To meet industry's needs for a small size, moderately-priced indicating gage of guaranteed accuracy and with a full-length 270° scale, the Foxboro Company, Foxboro, Mass., has developed the instrument shown here. This gage is so designed that it uses a full-length Bourdon spring to result in a reduction in movement multiplication and an increase in inherent accuracy. It is accurate to within 1 per cent of its total scale, says the manufacturer.

The gage is furnished in a drawn brass case and ring with buffed nickel finish. Buffed brass or chromium finish can also be supplied. The connection may be either top, bottom, left or right side. Dials may be had either with black background and white block figures, or white background and black figures. A plain, tapered pointer is used. Any range from 0-15 lb per sq in. to 0-300 lb, as well as 0-30 in. mercury vacuum, can be furnished.

## Motors for Assembly Announced

The Ohio Electric Mfg. Co., 5900 Maurice Ave., Cleveland, Ohio, has developed a line of motors consisting of stators substantially constructed and wound as illustrated, suitable for direct assembly into machine drives by the user. The stator,



which is ground to exact dimensions, is pressed into the machine, leads are brought out to a starting and stopping switch, the rotor is mounted on the shaft, and assembled. Ample openings for natural circulation or a fan for forced circulation are desirable to provide ventilation, but the motors can be wound to run without ventilation.

Polyphase types for 110 to 550 volts are offered; horsepowers range from ⅜ to 2.

## New Self-Contained Room Coolers

Two types of self-contained comfort room coolers with mechanical refrigeration have been made available by the Kauffman Air Conditioning Corp., 4485 Olive St., St. Louis, Mo. The ½-ton type (illustrated here) has an air delivery of 275 cfm, the motor is ½ hp, weight 400 lb, and the cabinet size is 29 in. long, 15 in. wide and 41 in. high. The cabinet is of furniture steel with a burl walnut finish. The 1-ton unit has an air delivery of 500 cfm, 1-hp motor, weighs 600 lb; the cabinet size is 39″ x 16½″ x 50″.

(*To page 70, back Advertising Section*)

Heating · Piping
and Air Conditioning

# American Society of Heating and Ventilating Engineers
# JOURNAL SECTION

1895

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# Physiologic Changes During Exposure to Ionized Air*

*By* C. P. Yaglou,† *(MEMBER)* A. D. Brandt,‡ and L. C. Benjamin§ *(NON-MEMBERS)*

Boston, Mass.

*This paper is the result of research conducted at Harvard University, School of Public Health, Boston, Mass., in cooperation with the Research Laboratory of the* AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.

THIS is the third paper of a series on the problem of ionization in relation to ventilation and health (1, 2). It deals with the physiologic effects of artificially ionized air on human subjects at rest under basal and normal dietary conditions.

The first comprehensive study of the biologic and clinical effects of ionized air was published in 1931 by Dessauer and his associates (3, 4). The ions used in this previous work consisted of charged submicroscopic particles of magnesium oxide dust having mobilities between 0.007 and 0.0018 cm/sec/volt/cm. Air with an ion count of 10 per cubic centimeter was administered to patients by means of a funnel placed over the face of the subject, who inhaled the ionized air for periods varying from 15 min to an hour.

Under these conditions Dessauer found an apparent opposite physiologic effect of positive and negative ions on both normal subjects and patients of the clinic. As a rule, positive ions increased the respiration rate, basal metabolism, and blood pressure, while negative ions decreased these functions. In most instances the inhalation of positive ions resulted in headaches, dizziness, nausea, and a feeling of fatigue; negative ions, on the other hand, produced a feeling of exhilaration and an apparent improvement in health.

The study to be described in the present paper began about the middle of 1930. Preliminary experiments with small positive ions yielded results somewhat in accord with Dessauer's; however, the whole series was discarded because of a suspected vitiation by ozone, which was present in appreciable concentrations as a by-product of early ionization methods. Subsequent experiments (since January, 1931) with improved apparatus have not entirely confirmed the preliminary observations and Dessauer's conclusions.

## Character of Ions Used and Method of Administration

The ions used in the present study were of the small molecular type having on an average a mobility of 1.3 cm/sec/volt/cm in the breathing zone of the experimental chamber. The entire quantity of air supplied to the room was ionized so that the subjects were wholly exposed to the influence of the ions. The concentration of positive and negative ions in different experiments was varied from a minimum of about 5,000 per cubic centimeter of air to a maximum of 1,500,000. (Normal air contains from 50 to 800 small ions per cc.) Respectively within the limits of these two concentrations from 50 to 99 per cent of the ions were absorbed by the rubber diaphragm of the respiration valves during the period of determining the subjects' oxygen consumption. In other words, during this period (10 to 20 min) the subject breathed air containing only a small fraction of the ions present in the room air. Concentrations in excess of 1,000,000 unipolar ions per cubic centimeter of air proved impracticable owing to the accumulation of bothersome static charges on the bodies of subjects, on apparatus, etc. All ion counts were made in the breathing zone of the patients, using a suitable counter similar to that described in the first paper (1).

The ionizers employed were capable of producing either positive or negative ions alone, to the exclusion of the other, or mixtures of positive and negative ions in any desired quantities and proportions. In the experiments with unipolar ions the concentration of the unwanted ions was much less than that present in ordiary air, owing to rapid neutralization by the artificial ions.

## Method of Study

All experiments were carried out in the psychrometric chamber of the school, which is equipped with a complete air conditioning apparatus. Outdoor air, heated to a comfortable temperature, according to the requirements of the subjects, was circulated through the room at a rate as high as 35 air changes per hour (1,800 cfm) in order to maintain normal chemical composition in the inspired air. No attempt was made to humidify the air in cold weather nor to cool it in warm weather; the purpose of this was to avoid as much as possible the complicating influence of adaptation to temperature and humidity changes.

The experiments were divided into three series, (*a*) those under standard basal conditions, (*b*) those from two to four hours after breakfast, and (*c*) those three to five hours after a light lunch. Most of the observations were carried out in the morning between 9

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and 12:30. The general plan was as follows: the subjects, one to three at a time, came to the laboratory about 9 a. m. (or 2 p. m.) and lay quietly and comfortably on cots for a preliminary period of one to two hours. During this resting period, the pulse rate, blood pressure, and respiration rate were taken at intervals until they assumed a steady level. At the end of this time the mouth temperature and metabolism were determined at least once. In many experiments arterial and finger blood was taken for a study of blood changes after completing all the foregoing observations. These data will be presented in another paper.

Having established a definite base line in this way, the ionizer was turned on, and adjusted so as to produce the desired sign and concentration of ions. All other conditions were kept unaltered. As a rule, exposure to the ionized air was limited to about an hour, though in a few experiments it varied from half an hour to three hours. During this ionization period all the observations listed were repeated at intervals, and near the end of the test the subjects were questioned about their sensations and general impressions.

In some of the experiments showing appreciable physiologic changes on exposure to ionized air, the observations were continued for one-half to one hour after the ionization period, without letting the subjects know that the ionizer was turned off. In a special series of control experiments the subjects as-

**Table 1—Physiologic Changes During Exposure to Ionized Air**

(Summary of Individual Observations on 15 Subjects)

| Subject No. | Sex | Age | Weight, Kg | Height, Cm | Date of Experiment | Ions per cc of Air: Positive | Ions per cc of Air: Negative | Exposure to Ionized Air, Min. | Dietary Condition | Calories per Hour: Harris-Benedict Basal Standard | Calories per Hour: Before Ionization | Calories per Hour: During Ionization | Calories per Hour: After Ionization | Respiration Rate: Before | Respiration Rate: During | Respiration Rate: After | Pulse Rate: Before | Pulse Rate: During | Pulse Rate: After | Blood Pressure Mm Hg: Before: Systolic | Blood Pressure Mm Hg: Before: Diastolic | Blood Pressure Mm Hg: During: Systolic | Blood Pressure Mm Hg: During: Diastolic | Blood Pressure Mm Hg: After: Systolic | Blood Pressure Mm Hg: After: Diastolic | Oral Temp. F: Before | Oral Temp. F: During | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | M | 46 | 60 0 | 180 | 4–21–33 | | 250000 | 37 | Basal | 62 | 62 | 61 | | 21 | 15 | | 67 | 63 | | 110 | 73 | 104 | 68 | | | 97.7 | 97.8 | Apparently normal. |
| 1 | | | 60 0 | | 4– 7–33 | 150000 | | 45 | Basal | 62 | 61 | 53 | | 22 | 19 | | 69 | 64 | | 89 | 60 | 104 | 72 | | | 98.3 | 98.2 | Apparently normal. |
| 1 | | 45 | 61 0 | | 11– 1–32 | 100000 | | 46 | After breakfast | | 75 | 69 | | 20 | 15 | | 68 | 66 | | 115 | 65 | 112 | 71 | | | 98.0 | 97.7 | Apparently normal. |
| 1 | | | 60 0 | | 1–20–31 | 20000 | 3000 | 70 | After breakfast | | 56 | 67 | 60 | 21 | 17 | 18 | 83 | 70 | 74 | 117 | 67 | 114 | 70 | 118 | 69 | 98.4 | 98.0 | Subject in run down condition. |
| 2 | F | 27 | 58 5 | 161 | 3–28–33 | | 100000 | 65 | Basal | 55 | 44 | 55 | | 13 | 12 | | 65 | 66 | | 83 | 54 | 92 | 57 | | | 98.4 | 98.3 | |
| 2 | | | 59 0 | | 2–28–33 | 500000 | | 70 | Basal | 55 | 57 | 57 | | 10 | 15 | | 63 | 63 | | 82 | 53 | 92 | 57 | | | 98.3 | 98.3 | |
| 2 | | 26 | 59 0 | | 1–26–31 | 10000 | 3000 | 63 | After lunch | | 70 | 65 | | 16 | 14 | | 79 | 74 | | 93 | 53 | 92 | 56 | | | 99.1 | 99.2 | Apparently Normal. |
| 6 | M | 44 | 72 5 | 173 | 3–16–31 | 10000 | 1500 | 107 | Basal | 68 | 57 | 62 | 57 | 17 | 16 | | 58 | 50 | 52 | 86 | 56 | 105 | 69 | 97 | 65 | 97.8 | 97.4 | |
| 6 | | | 73 0 | | 3–10–31 | 10000 | 500 | 73 | Basal | 68 | 54 | 61 | 57 | | | | 60 | 55 | 60 | 113 | 67 | 113 | 69 | 120 | 71 | 98.0 | 97.8 | Voluntary restricted diet. |
| 6 | | | 71 0 | | 3–27–31 | 10000 | 1500 | 135 | After breakfast | | 76 | 71 | | | | | 66 | 64 | | 88 | 60 | 97 | 59 | | | 98.3 | 98.3 | Voluntary restricted diet. |
| 7 | M | 25 | 59 0 | 179 | 3–16–31 | 10000 | 1500 | 61 | After breakfast | (67) | 60 | 81 | 76 | 19 | 14 | 16 | 68 | 66 | 67 | 114 | 68 | 111 | 71 | 111 | 72 | 98.4 | 98.6 | Severe cold restricted diet. |
| 10 | M | 32 | 55 5 | 168 | 7–14–32 | | 100000 | 57 | After breakfast | (61) | 81 | 77 | 79 | | | | 70 | 62 | 61 | 123 | 60 | 116 | 62 | 120 | 63 | 98.6 | 98.4 | Slender and weak. |
| 16 | F | 33 | 61 0 | 174 | 2–22–33 | 1000000 | | 72 | Basal | 55 | 65 | 61 | 69 | 18 | 16 | 18 | 66 | 66 | 68 | 83 | 51 | 88 | 57 | | | 97.5 | 97.4 | Apparently normal. |
| 16 | | | | | 11–11–32 | 1250000 | | 49 | After breakfast | | 69 | 67 | | 16 | 16 | | 68 | 64 | 71 | 92 | 59 | 98 | 69 | 97 | 67 | 97.8 | 97.6 | Apparently normal. |
| 16 | | | | | 7–14–32 | | 100000 | 70 | After breakfast | | 70 | 65 | 66 | 16 | 12 | | 70 | 66 | | 91 | 62 | 97 | 66 | 97 | 64 | | 98.5 | |
| 17 | M | 24 | 67 0 | 186 | 3–10–33 | | 500000 | 58 | Basal | 73 | 73 | 73 | | 14 | 13 | | 78 | 74 | | 114 | 67 | 113 | 68 | | | 98.1 | 97.9 | |
| 17 | | | | | 2–22–33 | 500000 | | 71 | Basal | 73 | 76 | 71 | | 17 | 12 | | 66 | 66 | | 95 | 56 | 115 | 73 | | | 97.5 | 97.6 | |
| 17 | | | | | 7–15–32 | | 100000 | 65 | After breakfast | | 72 | 67 | 72 | 15 | | | 70 | 61 | 64 | 108 | 65 | 108 | 65 | 112 | 68 | 97.6 | 97.7 | Apparently normal. |
| 18 | M | 36 | 63 0 | 169 | 3– 1–33 | | 500000 | 70 | Basal | 64 | 66 | 66 | | 14 | 15 | | 66 | 64 | | 105 | 65 | 100 | 69 | | | 97.5 | 97.6 | |
| 18 | | | | | 7–13–32 | | | 25 | After breakfast | | 92 | 84 | 80 | | | | 83 | 74 | 84 | 114 | 69 | 112 | 64 | 114 | 71 | 98.6 | 98.5 | Apparently normal. |
| 25 | M | 35 | 55 5 | 154 | 4–15–33 | | 250000 | 67 | Basal | 57 | 57 | 59 | | 19 | 21 | | 64 | 65 | | 128 | 87 | 127 | 83 | | | 97.7 | 98.0 | |
| 25 | | | | | 11–15–32 | 150000 | 50000 | 69 | After lunch | | 86 | 82 | 82 | | | | 77 | 77 | 79 | 138 | 82 | 129 | 87 | 140 | 93 | 98.3 | 97.8 | Japanese, apparently normal. |
| 30 | F | 27 | 59 0 | 162 | 11–11–32 | 500000 | | 50 | After breakfast | (55) | 72 | 63 | 72 | | | | 84 | 80 | 75 | 125 | 70 | 114 | 73 | 119 | 72 | 98.6 | 99.0 | History of heart trouble. |
| 40 | M | 29 | 87 0 | 179 | 4– 7–33 | 150000 | | 44 | Basal | 82 | 77 | 83 | | 12 | 14 | | 69 | 64 | | 85 | 56 | 105 | 72 | | | 98.0 | 97.9 | |
| 40 | | | | | 1–27–33 | 1000000 | | 73 | Basal | 82 | 82 | 76 | | 16 | 14 | | 59 | 59 | | 95 | 64 | 115 | 73 | | | 97.4 | 97.4 | Apparently normal. |
| 45 | F | 15 | 39 5 | 158 | 4– 8–33 | | 1500000 | 69 | Basal | 51 | 54 | 48 | | 17 | 15 | | 67 | 69 | | 107 | 65 | 107 | 66 | | | 97.7 | 97.7 | |
| 45 | | | 39 0 | | 2– 9–33 | 150000 | | 63 | After lunch | | 59 | 55 | | 19 | 16 | | 74 | 72 | | 122 | 78 | 112 | 79 | | | | 98.5 | Malnourished. |
| 51 | M | 24 | 70 0 | 163 | 4–15–33 | | 500000 | 79 | Basal | 70 | 70 | 69 | 69 | 24 | 20 | 17 | 69 | 64 | 67 | 120 | 74 | 109 | 72 | 109 | 72 | 97.1 | 97.1 | History of heart trouble. |
| 59 | M | 49 | 69 0 | 164 | 4–14–33 | 150000 | | 67 | Basal | 63 | 56 | 64 | 62 | 18 | 17 | 17 | 52 | 57 | 53 | 97 | 57 | 99 | 59 | 108 | 66 | 98.0 | 97.7 | Apparently malnourished. |
| 59 | | | 70 0 | 180 | 1–14–33 | 150000 | | 69 | Basal | 74 | 68 | 67 | 66 | 19 | 17 | 18 | 67 | 58 | 58 | 102 | 66 | 102 | 66 | 103 | 66 | 98.1 | 97.9 | Apparently normal. |

sumed that the air was being ionized, though as a matter of fact they were exposed only to normal air throughout the test period. The chief purpose of these control experiments was to study the influence of the prolonged rest, food, the psychic factor, etc., on the physiologic functions.

With the exception of four instances, the observations under basal conditions were made according to the generally accepted standard practice following Benedict's (5) outline of prerequisites Briefly these are (*a*) that the patient must have no food for at least 12 hours before the observations; (*b*) that he should be lying quietly and comfortably in an environment which is neither too warm nor too cool; (*c*) that he should not have a febrile temperature; (*d*) that he should be in complete muscular repose and without psychic disturbance and tension.

In the four exceptional cases the subjects had a very small breakfast three hours or more before making observations. This had little or no effect on the basal functions, as was also the case in Benedict's (6) and Du Bois's (7) experiments, and it improved immensely the psychologic attitude of the subjects toward the experiment.

The metabolism was determined by the Tissot open-circuit method except in a few instances in which the closed-circuit oxygen consumption method was employed. The subject inhaled room air through a special *inhalator mask* which covered closely the mouth and nose. He breathed normally by nose or mouth, and the expired air was collected in a spirometer after two rinsings. A pair of Loven's (8) rubber diaphragm valves were used to separate the inspired from the expired air. The expired air was sampled in mercury sampling tubes and analyzed in a Haldane gas analysis apparatus on the day of the experiments.

New subjects who had no experience in breathing through a mask were given an opportunity to try it for short periods and become accustomed to the routine before making actual measurements. In a number of instances the data of the first and second determination had to be discarded, either because of careless leaks through the pneumatic seal of the mask or because of psychic disturbance in the patient while inhaling through the mask. Routine tests for leaks were made by reading the spirometer every minute or two, and by testing the whole circuit periodically. Any questionable results were discarded. Fortunately most of the subjects were employees of the school and were fairly familiar with the whole procedure.

The blood pressure was determined by the auscultatory method, using a Baumanometer (mercury column) and a bracelet stethoscope. The first clear thumping sound indicated the systolic pressure, and the disappearance of all sound (fifth phase) was taken as the diastolic criterion, except in two instances in which the fourth auscultatory phase had to be chosen.

## Results

The results in this paper are based on 141 experiments with 60 individuals between the ages of 10 and 68 years. Twenty-five were females and 35 males. Of the total number of subjects, 45 were apparently healthy and of the remaining 15, seven were affected by arthritis, one had pulmonary tuberculosis, one hypertension, two were affected by extreme nervousness, one by anemia, and three by malnutrition.

**Table 2—Metabolic Changes in Ionized Air**

| Heat Production in Normal Air in Percentage of Harris-Benedict Basal Standards | 75–84 (A) | 85–94 (B) | 95–104 (C) | 105–114 (D) | 115–124 (E) | 125 and Over (F) |
|---|---|---|---|---|---|---|
| **OBSERVATIONS UNDER BASAL CONDITIONS** | | | | | | |
| Average heat production, in % of H.-B. Standards | 81.0 | 91.7 | 100.2 | 108.6 | 121.0 | |
| Av. change in ionized air in % of H.-B. standards | +12.7 | +6.0 | −2.4 | −4.0 | −9.0 | |
| No. of observations (23 subjects) | 3 | 3 | 12 | 8 | 2 | |
| No. showing increase (+2 cals. or more) | 3 | 2 | 2 | 1 | 0 | |
| No. showing no change (within ±2 cals.) | 0 | 1 | 5 | 1 | 0 | |
| No. showing decrease (-2 cals. or more) | 0 | 0 | 5 | 6 | 2 | |
| **OBSERVATIONS 2 TO 4 HOURS AFTER BREAKFAST** | | | | | | |
| Average heat production, in % of H.-B. basal standards | 78.0 | 92.7 | 98.9 | 108.8 | 118.8 | 133.4 |
| Av. change in ionized air in percentage of H. - B. standards | +30.0 | +19.7 | +2.6 | −3.4 | −6.8 | −22.7 |
| No. of observations (35 subjects) | 1 | 3 | 12 | 19 | 11 | 13 |
| No. showing increase | 1 | 2 | 6 | 3 | 1 | 0 |
| No. showing no change | 0 | 0 | 2 | 4 | 1 | 0 |
| No. showing decrease | 0 | 1 | 4 | 12 | 9 | 13 |
| **OBSERVATIONS 3 TO 5 HOURS AFTER LUNCH** | | | | | | |
| Av. heat production, in % of H.-B. basal standards | | 90.0 | 98.5 | 110.9 | 119.9 | 134.1 |
| Av. change in ionized air in percentage of H. - B. standards | | +18.0 | +10.5 | −0.9 | −3.5 | −12.9 |
| No. of observations (24 subjects) | | 1 | 2 | 8 | 11 | 16 |
| No. showing increase | | 1 | 2 | 3 | 2 | 0 |
| No. showing no change | | 0 | 0 | 1 | 2 | 0 |
| No. showing decrease | | 0 | 0 | 4 | 7 | 16 |

A summary of individual observations on 15 subjects is given in Table 1 and the average changes among homogeneous groups of subjects are presented in Tables 2 to 7. The significance of the physiologic changes in Table 1 will become more apparent after considering first the general trends. It is sufficient to say at this point that within the limits of the experiments the changes observed with positive and negative ionization were quite similar, regardless of concentration of ions. For this reason the data have been grouped together irrespective of sign or concentration, in establishing the general trend.

The threshold and optimum concentrations of ions for ventilation work will be taken up in another paper.

*Changes in Metabolism.*—In Table 2 are shown the changes in heat production (*a*) under basal conditions, (*b*) two to four hours after breakfast, and (*c*) three to five hours after lunch. The results are based on a total of 125 sets of observations out of a total of 141 tests; the difference represents the number of questionable observations on new subjects which had to be discarded. The actual metabolism is expressed in percentage of the Harris-Benedict (9, 5) normal basal standards. The average change in heat production on exposure to ionized air is the mean of the individual

**Table 3—Respiratory Changes in Ionized Air in Relation to Metabolic Changes**

(Consolidated data of three series of observations)

| Per Cent Change in Actual Heat Production | +25 or More | +24 to +15 | +14 to +5 | +4 to −5 | −6 to −15 | −16 or More |
|---|---|---|---|---|---|---|
| Av. change in heat production (%) | +32.2 | +18.0 | +9.0 | −1.1 | −9.0 | −22.3 |
| Av. change in lung ventil. rate (%) | +23.5 | +11.7 | +5.9 | −0.9 | −7.9 | −16.3 |
| No. of observations (60 subjects) | 4 | 3 | 15 | 49 | 42 | 10 |
| No. showing increase (+2% or more) | 4 | 2 | 12 | 20 | 3 | 0 |
| No. showing no change (within ±2%) | 0 | 1 | 0 | 8 | 5 | 0 |
| No. showing decrease (−2% or more) | 0 | 0 | 3 | 21 | 34 | 10 |
| Av. change in respiration rate (%) | −13.7 | −7.2 | −1.5 | −2.4 | −7.9 | −6.8 |

**Table 4—Changes in Respiration Rate During Exposure to Ionized Air**

(Consolidated results of three series of observations)

| Respiration Rate in Normal Air | 9–13 (A) | 14–19 (B) | 20 and Over (C) |
|---|---|---|---|
| Average respiration rate | 11.5 | 16.8 | 21.3 |
| Av. change on exposure to ionized air | +2.0 (+17.4%) | −1.4 (−8.0%) | −3.5 (−16.4%) |
| No. of observations (47 subjects) | 8 | 62 | 17 |
| No. showing increase | 6 | 8 | 0 |
| No. showing no change | 1 | 7 | 1 |
| No. showing decrease | 1 | 47 | 16 |

changes which were classified according to the initial heat production at the *steady state* (before ionization).

Referring to the observations under basal conditions (Table 2) the minimum change during exposure to ionized air occurred in group *C* in which the heat production before ionization was within ± 5 per cent of the normal standards. A definite increase took place in five of the six instances of Groups *A* and *B* in which the initial heat production was less than 95 per cent of the normal, the average increase being 12.7 per cent and 6.0 per cent respectively for the two groups. Reversely, the basal metabolism rate decreased in eight of the ten instances in which it was more than 105 per cent of the normal (Groups *D* and *E*), the average decrease being 4.0 per cent and 9.0 per cent for Groups *D* and *E* respectively.

In Group *A* showing an initial basal metabolism less than 85 per cent of the normal, there were two men and one woman. One of the men (See Table 1, Subject 6), an employee of the School was under a voluntary restricted diet, losing weight rapidly. Two observations about three weeks apart showed basal metabolic rates of 78 and 80 per cent of the normal in spite of a small breakfast on both occasions. The second man was a professional subject apparently in a malnourished condition at the time of the experiments. He was studied three times and found to have a consistently subnormal metabolic rate. The woman in the group, one of the author's (L. C. B.), showed no abnormality to account for the spontaneous low metabolism. On four other occasions her metabolic rate was well within the normal range.

There is also no obvious reason for the comparatively high basal metabolism in the two subjects of Group *E* except that one of them was very small, weighing only 45.5 kg. Both were women about 60 years old, affected by rheumatic conditions.

In the series of observations made after the subjects had eaten breakfast or lunch, the changes in heat production following exposure to ionized air are quite concordant with those of the basal series (Table 2). Under the conditions of the experiments, breakfast in itself increased the heat production in normal air on an average of about 10 per cent above the Harris-Benedict basal standards, and a light lunch increased it by about 20 per cent. In other words the average normal metabolic rate before ionization was about 110 per cent of the basal standard in the experiments after breakfast, and about 120 per cent in the experiments after lunch. Correspondingly, little change took place in ionized air in Groups *C* and *D* after breakfast, and in Groups *D* and *E* after lunch. In the remaining groups the metabolism was appreciably affected.

The five subjects in Groups *A* and *B* showing subnormal initial metabolic rates despite the stimulating action of food were affected by such conditions as anemia, malnutrition or a run-down condition.

In instances in which the observations were continued after the ionization period, the metabolic rate tended to return to its pre-ionization level, as can be seen in Table 1.

*Respiratory Changes.*—As shown in Table 3, the changes in metabolism were effected largely by variations in the lung ventilation rate rather than in the composition of the expired air. Variations in the pulmonary ventilation rate were in turn affected entirely by variations in depth rather than in rate of respiration. As a matter of fact, the respiration rate decreased on an average (Table 3), despite the increases in pulmonary ventilation and metabolism.

The changes in the respiration rate during the ionization period depended largely upon the initial rate in normal air (Table 4). Although as a rule the basal rate was the lowest, and that after lunch the highest of the three series of observations, the differences were too small to justify treating each series separately, as was done with the metabolism.

In some of the experiments, the respiration rate was counted only during the metabolism period when the subjects were breathing through the inhalator mask. These data are not included in Table 4 because the respiration as a rule was slower and deeper when the mask was worn than without it.

Of a total of 87 observations, in 62 (or 71 per cent) the respiration rate in normal air was between 14 and 19, averaging 16.8 per minute (Table 4). The average change in this group (*B*) on exposure to ionized air was —1.4 breaths per minute. In Group *A* showing initial rates between 9 and 13, the rate increased on an average of 2.0 breaths a minute during the ionization period whereas in Group *C*, having a respiration rate of 20 or more, the rate decreased by 3.5 breaths a minute The percentage change in Groups *A* and *C* is +17.4 per cent, and —16.4 per cent respectively.

The characteristics of respiration in breathing polarized air will be discussed in another paper. It may be of interest to note at this time that the respiration rate was more regular than in normal air, especially in subjects with irregular breathing, and that the depth of respiration was considerably increased.

*Changes in Pulse Rate.*—The pulse rate in normal air during the steady state varied widely among the subjects, particularly among the women. The maximum variation in the groups was from 50 to 96. As in the case of respiration rate, the basal pulse was somewhat lower than the rate after breakfast, and the rate after lunch was the highest; the changes in the three series, however, were sufficiently concordant to allow their being treated together as in Table 5.

The most popular pulse rate was between 66 and 75 in subjects under 40 years of age, and 65 or less (55-65) in subjects over 40 years. In these two groups there was a small decrease on exposure to ionized air which might be attributed to prolonged rest. The pulse rate in ionized air increased slightly in subjects under 40 years of age, showing initial rates of 65 or less, and decreased appreciably in the majority of subjects who had initial rates of 76 or more regardless of age.

Taken by themselves, these changes in pulse rate may have little physiologic significance except that they are consistent with those in metabolism, respiration, and blood pressure. After the ionization period, the pulse rate, like the metabolic rate, tended to return to its preionization level.

*Changes in Blood Pressure.*—The changes in blood pressure depended considerably on the age of the subject, as shown in Tables 6 and 7. Among persons under 25 years of age the normal (lying) systolic blood pressure of the majority during the steady state ranged between 90 and 114, and the change in ionized air was slight. (+1.8 mm Hg). In subjects of the same age group who showed initial systolic pressures between 115 and 129, the pressure was reduced by an average of 11.0 mm during exposures to ionized air.

Of the three age groups the oldest had the highest blood pressure, and seemed to be affected most during the ionization period. On an average, the systolic pressure in this group increased 12.2 mm when the preionization pressure was less than 90 mm, and decreased 13.1 mm when the initial pressure was 130 mm or more.

It may be worth noting that in the pressure group of 115 to 119 mm (Table 6), persons under 25 years received a significant decrease, whereas those over 40 were but little affected by ionization. The blood pressure readings on the single subject suffering from hypertension (245 mm Hg) have been omitted from Table 6 in order to avoid distortion of the general trend.

Changes in diastolic pressure during the ionization period are presented in Table 7.

As in the case of metabolism, respiration, and pulse rate, the blood pressure also showed a tendency to return to its preionization value after the ionizer was turned off (See Table 1).

*Changes in Body Temperature.*—The body (oral) temperature varied but little during the ionization period, despite the substantial changes in metabolism (Table 1).

*Physiologic Changes in Control Experiments.*—In Table 8 are presented the results of control experiments which were carried out under the conditions of the three main series, except for the omission of the ionization period. The data shown, except those for the metabolism, are averages of the values recorded after resting

**Table 5—Changes in Pulse Rate During Exposure to Ionized Air**
(Consolidated data of three series of observations)

| Pulse Rate in Normal Air | 65 or Less | 66–75 | 76 and Over |
|---|---|---|---|
| **Age Under 40 Years** | | | |
| Average pulse rate | 61.4 | 69.8 | 81.6 |
| Average change in ionized air | +1.8 | −2.3 | −7.1 |
| Number of observations (44 subjects) | 21 | 46 | 39 |
| No. showing increase (+2 or more) | 9 | 5 | 0 |
| No. showing no change (within ±2) | 8 | 12 | 7 |
| No. showing decrease (−2 or more) | 4 | 29 | 32 |
| **Age 40 Years and Over** | | | |
| Average pulse rate | 63.3 | 69.7 | 82.7 |
| Average change in ionized air | −0.2 | −4.3 | −7.8 |
| No. of observations (16 subjects) | 19 | 10 | 6 |
| No. showing increase | 8 | 0 | 0 |
| No. showing no change | 4 | 1 | 0 |
| No. showing decrease | 7 | 9 | 6 |

**Table 6—Changes in Systolic Blood Pressure during Exposure to Ionized Air**
(Consolidated results of three series of observations.)

| Systolic Blood Pressure in Normal Air. (mm Hg) | Under 90 | 90–114 | 115–129 | 130 and Over |
|---|---|---|---|---|
| **AGE UNDER 25 YEARS** | | | | |
| Average pressure | (88.0) | 106.4 | 120.9 | |
| Av. change in ionized air (mm Hg) | (+1.0) | +1.8 | −11.0 | |
| No. of observations (8 subjects) | 1 | 23 | 8 | |
| No. showing increase (+2 mm or more) | 0 | 7 | 0 | |
| No. showing no change (within ±2 mm) | 1 | 13 | 0 | |
| No. showing decrease (−2 mm or more) | 0 | 3 | 8 | |
| **AGE 25 TO 39 YEARS** | | | | |
| Average pressure | 83.9 | 102.9 | 120.8 | 138.0 |
| Av. change in ionized air | +9.8 | +0.9 | −3.7 | −6.7 |
| No. of observations (36 subjects) | 9 | 48 | 11 | 6 |
| No. showing increase | 9 | 20 | 2 | 0 |
| No. showing no change | 0 | 12 | 3 | 1 |
| No. showing decrease | 0 | 16 | 6 | 5 |
| **AGE 40 YEARS AND OVER** | | | | |
| Average pressure | 87.7 | 108.2 | 120.2 | 143.5 |
| Av. change in ionized air | +12.2 | +1.6 | ±0.0 | −13.1 |
| No. of observations (15 subjects) | 4 | 14 | 8 | 8 |
| No. showing increase | 4 | 6 | 2 | 0 |
| No. showing no change | 0 | 1 | 3 | 3 |
| No. showing decrease | 0 | 7 | 3 | 5 |

**Table 7—Changes in Diastolic Pressure during Exposure to Ionized Air**
(Consolidated results of three series of observations.)

| Diastolic Blood Pressure in Normal Air. (mm Hg) | Under 60 | 60–69 | 70–79 | 80 and Over |
|---|---|---|---|---|
| **AGE UNDER 25 YEARS** | | | | |
| Average pressure | 56.4 | 63.5 | 74.3 | |
| Av. change in ionized air (mm Hg) | +8.1 | +2.3 | −3.0 | |
| No. of observations (8 subjects) | 10 | 18 | 4 | |
| No. showing increase (+2 mm. or more) | 9 | 10 | 1 | |
| No. showing no change (within ±2 mm) | 1 | 7 | 1 | |
| No. showing decrease (−2 mm or more) | 0 | 1 | 2 | |
| **AGE 25 TO 39 YEARS** | | | | |
| Average pressure | 54.2 | 64.2 | 74.4 | 85.2 |
| Av. change in ionized air | +5.6 | +1.0 | +0.5 | ±0.0 |
| No. of observations (36 subjects) | 32 | 26 | 11 | 5 |
| No. showing increase | 23 | 11 | 5 | 2 |
| No. showing no change | 5 | 7 | 4 | 1 |
| No. showing decrease | 4 | 8 | 2 | 2 |
| **AGE 40 YEARS AND OVER** | | | | |
| Average pressure | 56.2 | 65.3 | 74.9 | 84.1 |
| Av. change in ionized air | +6.7 | +2.1 | +2.6 | −5.1 |
| No. of observations (15 subjects) | 6 | 10 | 8 | 10 |
| No. showing increase | 5 | 6 | 4 | 0 |
| No. showing no change | 1 | 1 | 3 | 2 |
| No. showing decrease | 0 | 3 | 1 | 8 |

periods of one, two, and three hours approximately. The subjects knew nothing of the purpose of these tests, and they probably assumed that the air was being ionized as usual.

The variations in the physiologic functions under basal conditions are too small to be of any significance (Table 8). In the experiments after breakfast and after lunch the variation is greater than in the basal series, but the direction of the change is irregular and inconsistent with that in Tables 1 to 7. Judging from this relatively small number of control tests, the average changes as shown at the right of Table 8 appear to be too small to account for the alterations observed following the administration of ionized air.

## Subjective Sensations in Ionized Air

In the first 17 experiments the ionizer produced a distinct buzzing sound which aroused apprehension, particularly in three new subjects. Judging from their remarks, they expected something unusual to happen and were rather disappointed because nothing occurred. The condition was probably aggravated by questioning the subjects concerning transitional changes in their sensations immediately after turning the ionizer on, a practice which was soon discontinued. Needless to say, all questionable observations have been discarded.

In most instances, subjects from outside the School knew little or nothing about the ionization part of the experiment, and only a few in the whole group knew whether the ions were positive, negative, or mixtures of the two.

Table 9 shows the sensations recorded at the close of the tests. Approximately in 15 to 30 per cent of the observations there was no subjective change whatever, and the subjects were unconcerned as to whether the ionization was positive, negative, or a mixture.

In experiments with positive ions, the most definite sensations which were reported with sufficient regularity by a certain group of subjects (evidently sensitive to positive ions) to make the data valid, are dryness and irritation in the nose and throat, and frontal headaches (Table 9). This is entirely in accord with Dessauer's experience (3). The apparent superiority in freshness and stimulating quality of mixtures of positive and negative ions (the former predominating) was most noticeable in the first 17 experiments in which there was a trace of ozone in the air, although the concentration was below the threshold of detection by the potassium-iodide starch method. Strips of white blotting paper dipped into a fresh iodide-starch solution turned in color on exposure to the stream of ionized air before the latter mixed with the main ventilating current, but the strips dried up without changing color on exposure to the breathing zone of the room.

In all subsequent experiments with improved ionizers (producing no ozone) this superiority did not persist. In a special series of tests with ozone concentrations

**Table 8—Physiologic Changes in Control Experiments**

(No Artificial Ionization)

| Resting Period in Normal Air—Hours | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | Average Change 1st to 2nd Hour | 2nd to 3rd Hour | 1st to 3rd Hour |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Observations Under Basal Conditions** | Subject #2 Female, 27 Years | | | Subject #7 Male, 25 Years | | | Subject #8 Male, 46 Years | | | | | | | | |
| Actual heat production, calories per hour | 58.7 | ..... | 58.2 | 68.6 | ..... | ..... | 65.7 | 66.0 | 65.4 | | | | +0.3 | −0.6 | −0.4 |
| Heat production in % of H.-B. standards | 107 | ..... | 106 | 102 | ..... | ..... | 97 | 97 | 96 | | | | ±0.0 | −1.0 | −1.0 |
| Respirations per minute | 14 | 13 | 14 | 18 | 17 | 17 | 13 | 14 | 12 | | | | −0.3 | −0.3 | −0.7 |
| Pulse rate | 68 | 68 | 68 | 64 | 62 | 65 | 63 | 63 | 64 | | | | −0.7 | +1.3 | +0.7 |
| Systolic blood pressure, mm. Hg. | 85 | 82 | 85 | 112 | 109 | 112 | 118 | 120 | 118 | | | | −1.3 | +1.3 | ±0.0 |
| Diastolic blood pressure, mm. Hg. | 53 | 49 | 50 | 72 | 69 | 71 | 69 | 70 | 70 | | | | −2.0 | +1.0 | −1.0 |
| Oral temperature, F. | 99.1 | 99.0 | 99.0 | 98.3 | 98.3 | 98.1 | 98.0 | 97.8 | 97.8 | | | | −0.1 | −0.1 | −0.2 |
| **Observations Two to Four Hours After Breakfast** | Subject #11 Male, 44 Years | | | Subject #13 Male, 32 Years | | | Subject #59 Male, 49 Years | | | Subject #60 Male, 29 Years | | | | | |
| Actual heat production | 68.4 | 71.8 | ..... | 75.9 | 73.4 | ..... | 60.1 | ..... | 63.0 | 71.2 | ..... | 70.1 | +0.5 | ..... | +0.9 |
| Heat production in % of H.-B. standards | 118 | 124 | ..... | 110 | 106 | ..... | 96 | ..... | 100 | 96 | ..... | 94 | +1.0 | ..... | +1.0 |
| Respirations per minute | ..... | ..... | ..... | 17 | 18 | ..... | 16.5 | 15 | 16 | 18.5 | 18 | 18 | −0.3 | +0.5 | −0.5 |
| Pulse rate | 60 | 62 | ..... | 66 | 63 | ..... | 65 | 62 | 64 | 61 | 61 | 59 | −1.0 | ±0.0 | −1.5 |
| Systolic blood pressure | 87 | 89 | ..... | 113 | 109 | ..... | 99 | 97 | 103 | 99 | 96 | 103 | −1.8 | +6.5 | +4.0 |
| Diastolic blood pressure | 58 | 60 | ..... | 64 | 64 | ..... | 54 | 57 | 59 | 58 | 59 | 60 | +1.5 | +1.5 | +3.5 |
| Oral temperature | 98.5 | 98.4 | ..... | 98.4 | 98.0 | ..... | 98.1 | 98.1 | 98.2 | 97.7 | 97.7 | 97.6 | −0.1 | ±0.0 | ±0.0 |
| **Observations Three to Five Hours After Lunch** | Subject #2 | | | Subject #59 | | | Subject #60 | | | | | | | | |
| Actual heat production | 67.0 | 62.1 | 67.3 | 69.8 | 74.2 | 74.7 | 77.6 | 79.8 | 76.4 | | | | +0.6 | +0.8 | +1.3 |
| Heat production in % of H.-B. standards | 122 | 113 | 123 | 111 | 118 | 119 | 105 | 108 | 103 | | | | +0.3 | +2.0 | +2.3 |
| Respirations per minute | 20 | 21 | 18 | 18 | 18 | 18 | 16 | 18 | 18 | | | | +1.0 | −1.0 | ±0.0 |
| Pulse rate | 78 | 75 | 74 | 66 | 65 | 67 | 63 | 63 | 65 | | | | −1.3 | +1.0 | −0.3 |
| Systolic blood pressure | 89 | 85 | 88 | 100 | 109 | 107 | 101 | 98 | 102 | | | | +0.7 | +1.7 | +2.3 |
| Diastolic blood pressure | 51 | 50 | 50 | 59 | 65 | 66 | 57 | 60 | 64 | | | | +2.7 | +1.7 | +4.3 |
| Oral temperature | 99.0 | 99.0 | 99.0 | 98.3 | 98.2 | 98.2 | 97.9 | 97.9 | 97.6 | | | | ±0.0 | −0.1 | −0.1 |

**Table 9—Subjective Sensations in Ionized Air**
(Exposure 1 to 2 hours.)

| Sensations | Per cent of Total Observations | | | | | |
|---|---|---|---|---|---|---|
| | Positive Ions | Negative Ions | Positive and Negative | Positive Ions | Negative Ions | Positive and Negative |
| No change | 21.7 | 27.6 | 13.5 | 21.7 | 27.6 | 13.5 |
| Fresher | 1.3 | 10.3 | 21.7* | | | |
| General cooling effect | 5.4 | 12.9 | 0.0 | | | |
| Invigorating, stimulating | 10.8 | 9.5 | 32.4* | 40.5 | 71.5 | 73.0 |
| Relaxation | 8.1 | 21.6 | 2.7 | | | |
| Sleepiness | 9.5 | 12.9 | 10.8 | | | |
| Increased appetite | 5.4 | 4.3 | 5.4 | | | |
| Dryness and irritation of nose | 13.5 | 0.0 | 5.4 | | | |
| Headache | 13.5 | 0.9 | 5.4 | 37.8 | 0.9 | 13.5 |
| Restlessness | 2.7 | 0.0 | 0.0 | | | |
| Probable diuresis | 8.1 | 0.0 | 2.7 | | | |
| Total number of observations | 74 | 116 | 37 | 100.0% | 100.0% | 100.0% |

*Attributed largely to trace of ozone in the air.

**Table 10—Primary Sensations in Ionized Air**
(Special tests. Exposure 5 to 20 minutes.)

| Sensations | Per cent of Total Observations | | | |
|---|---|---|---|---|
| | Positive Ions | Negative Ions | Positive Ions | Negative Ions |
| No difference | 5.9 | 0.0 | 5.9 | 0.0 |
| Fresher | 32.3 | 45.5 | | |
| Easier to breathe | 0.0 | 15.1 | | |
| General cooling effect | 2.9 | 18.2 | | |
| Tingling in skin and nose | 8.8 | 9.1 | 46.9 | 100.0 |
| Invigorating, stimulating | 2.9 | 3.0 | | |
| Relaxation | 0.0 | 9.1 | | |
| Difficult to breathe | 11.8 | 0.0 | | |
| Dryness and irritation in nose | 14.8 | 0.0 | 47.2 | 0.0 |
| Headache | 8.8 | 0.0 | | |
| Depressing; dullness in head | 11.8 | 0.0 | | |
| Total number of observations | 34 | 33 | 100.0% | 100.0% |

distinctly perceptible to the nose, the sensation was that of irritation rather than freshness.

Negative ionization had a tendency to produce a cooling effect on the body, and this was most apparent in the summer tests when the skin of the subjects was more or less moist. The most popular sensation was one of relaxation and, in extreme cases, sleepiness (Table 9). In many instances these effects were discernible a few minutes after turning on the ionizer, and they occurred mainly in subjects having a comparatively high blood pressure, a high pulse rate, or a high metabolism. As a rule relaxation was concomitant with a fall in blood pressure, the pulse rate, and metabolism. Conversely, sensations of stimulation or invigoration were accompanied by an acceleration in these physiologic functions in subnormal cases.

Summing up the results in Table 9, it can be seen that 40.5 per cent of the sensations recorded after exposure to positive ions for one hour or more were of an agreeable nature, and 37.8 per cent were somewhat disagreeable. In negatively ionized air, on the other hand, 71.5 per cent of the sensations were of a desirable character, and there were almost no unpleasant effects. Despite this apparent favoritism to negative ionization, only 11 of a total of 45 subjects exposed to it for one hour or more expressed a strong liking for it and felt that they were benefited. All 11 were from the abnormal group of 15 subjects whose condition was described earlier in the paper.

Table 10 gives the results of a special series of tests in which interested visitors of the School during the past two years reported their sensations after the ionizer was turned on and off two or three times, and after short exposures. All persons in this group were fully aware that the air was being ionized, but most of them did not know just what polarity they were getting until after the test was over.

According to these data there seems to be an appreciable freshness in ionized air, particularly in the case of negative ionization, but as in the main experiments, the preference was not strong to suggest a definite improvement in the condition of the air, except in a few instances.

## Summary

The influence of ionized air (small ions) upon total metabolism, respiration, pulse rate, blood pressure, and body temperature, was studied on human subjects lying on cots, (*a*) under basal conditions, (*b*) two to four hours after breakfast, and (*c*) three to five hours after a light lunch. A group of 60 persons in a total of 141 experiments were exposed for a period of one hour or more to air containing from 5,000 to 1,500,000 ions per cubic centimeter (normal air contains from 50 to 800 small ions per cubic centimeter), after a preliminary resting period of one to two hours in normal air.

Under the experimental conditions ionized air appeared to exert a normalizing influence upon the organism by accelerating the physiologic processes in instances in which these processes were below the normal range of the majority of subjects, and reversely, by decreasing the physiologic activity in cases in which the functions were above the normal range. Following the ionization period there was a reversion of the functions toward their steady state prior to the ionization period. This indication, being of a somewhat surprising nature, requires verification by further experiments.

Although the physiologic response to positive and negative ions did not seem to differ greatly, certain differences were observed in the sensations produced by the two kinds of ions; positive ionization resulted in headaches and irritation in the nose and throat in some cases, whereas negative ionization predisposed to relaxation and other sensations of a desirable character. In a few instances these effects were discernible a few minutes after turning on the ionizer.

A minority of the subjects reported an appreciable freshness in ionized air, particularly in the case of negative ionization, but the preference was not strong enough to suggest a striking improvement in the condition of the air except in the case of abnormal persons. Out of the 45 subjects exposed to negatively ionized air for an hour or more, only 11 expressed a strong liking for it and felt that they were benefited. All 11 were from an abnormal group of 15 subjects. Even in such special cases, however, the effects of continuous exposure are unknown and not much is known about the optimum concentrations. The problem is now being studied in the laboratories of this School and in the wards of nearby hospitals.

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# Heads Up*

**Dr. S. M. Kintner†**

IN selecting a topic that I consider appropriate for this occasion I decided that what I will say might properly come well within the scope of that common expression "Heads Up." In using this I am not announcing the result of the flip of a coin, but am sounding that familiar admonition of the traffic policeman at a busy street crossing who many hundreds of times a day calls out "Heads Up" to those pedestrians about to cross. In other words, he cautions them to be alert so that they may avoid danger and yet be assured of a safe crossing. One of the principal thoughts I want you to remember, of what I say, is the one carried by the subject of my talk. There never has been a time when one needed to be more alert than the present. There never has been a time in the American business street when there were so many new and strange vehicles passing and, to add to the hazard, with so many new and untried drivers attempting to guide these new devices to a safe delivery of the goods. Under such conditions, it well behooves each of us to remember the warning of the traffic cop as we pedestrians attempt a crossing.

The new National Industrial Recovery Act is one of the newest and most radical of our new devices for fighting the depression. It is one of the new and strange vehicles on our business street that is not understood by anyone as yet. It simply passes to the President broad dictatorial powers to do most anything he desires in an attempt, during a limited emergency period, to restore prosperous conditions.

The bill will prove to be good or bad according to how it is administered. There are several conflicting groups whose efforts to get an advantage is quite manifest as one studies the act. If the administrator of this law can prevent any such efforts from becoming successful, he will have done a wonderful service.

That something had to be done quite different from our previous attempts, which were in effect equivalent to blood transfusions, is quite apparent now to all.

That we should support these sincere efforts in fighting this depression is equally apparent and calls for our whole-hearted support.

In your efforts in doing your part no better advice can be given than "Heads Up," for it is alertness that will do the most good in working us out of this troublesome time. The good hard headed common sense of American Business is needed to help guide these new vehicles and unless you each and everyone keep yourselves keenly alive to the progress that is being made and call it to the attention of those, who are driving, when it is getting off the right road, or approaching rough going—you will be guilty of slighting your duty.

The real true prosperity will come when and only when the idle workers are returned to their jobs; when their jobs pay them sufficiently well to enable them to buy more than simply the sheer necessities.

I hope our Industrial Recovery Act will provide the necessary starting force to get us over the dead center and start us off again in what should be our more normal condition of living.

There can be but little doubt that our machine methods of doing things enable us to do our essential work with less labor—this fact has caused various people to express one or the other of two extreme views, either, first, that the hours of labor will be reduced and production limited to the amounts found to be required or, second, that our developments of still other devices and other desires for new things will take up the slack labor—give present hours of employment and prosperity again rules.

Probably a compromise between these two will be found more nearly correct.

America was founded on the idea of success in proportion to individual initiative and effort.

*From an Address delivered before the *National Association of Building Owners and Managers*, Pittsburgh, Pa., June 19, 1933.

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# Tests of Convectors in a Warm Wall Testing Booth* (Part II)

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***This paper is the result of research conducted at the University of Illinois in cooperation with the Research Laboratory of the*** AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.

*The data presented in this paper were obtained in connection with an investigation conducted by the Engineering Experiment Station of the University of Illinois, of which Dean M. S. Ketchum is the Director. The work is carried on in the Department of Mechanical Engineering under the direction of A. C. Willard, Professor of Heating and Ventilation, and Head of the Department. This paper includes results from the part of the work constituting a continuation of the program devoted to the study of the performance of convectors in a warm wall booth and the material will ultimately comprise part of a bulletin of the Engineering Experiment Station.*

A PREVIOUS paper[1] on this subject was devoted to a discussion of tests run in a warm wall testing booth for the purpose of deciding the validity of the correction factor, applied in the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS' Standard Code for Testing and Rating Concealed Gravity Type Radiation (Steam Code)[2] for reducing the heat output obtained under test conditions to the equivalent heat output under standard conditions with steam in the heating unit at 215 F and a temperature of 65 F for the air at the inlet. This correction factor is:

$$C = \left[\frac{150}{t_s - t_i}\right]^{1.3}$$

*where* 150 = the temperature difference between steam at 215 F and inlet air at 65 F.

$t_s$ = the temperature of steam during the test.

$t_i$ = the inlet air temperature during the test.

This correction factor is the one commonly used in the case of cast-iron direct radiators and its validity has been well established when used in this connection, but its validity had not been well established when used in connection with convectors.

The results[1] in general indicated a close agreement between the heat output actually obtained with steam at 215 F and inlet air at 65 F, and that calculated from the heat output at some other inlet air temperature through the medium of the correction factor, provided that the inlet air temperature did not exceed 80 F or fall below 60 F. There seemed to be some indication, however, that the percentage deviation between the actual and calculated heat outputs might be affected by the physical dimensions of the convectors, particularly by the height of the cabinet. The tests were, therefore, continued for the purpose of determining to what extent the dimensions of the convectors influence the limits of accuracy in the application of the correction factor.

## Description of Apparatus

A section of the test booth and a detail of the piping are shown in Fig. 1 *A* and *B*. This has been fully described both in a previous paper[1] and in the A. S. H. V. E. Standard Code for Testing and Rating Concealed Gravity Type Radiation (Steam Code).[2]

Four types of convectors were tested. Two of these types were tested with three different heights of cabinets and one type was tested with two different heights of cabinets. Three types were tested with different widths of heating units and three with different lengths. The types and dimensions of all convectors are shown in Table 1 and in the insets in Figs. 2 to 7.

## Test Procedure

All tests were run with a steam temperature of 216.5 F in the convectors. In order to obtain curves for each convector, establishing the relation between the heat output, as measured by steam condensation, and the temperature of the air at inlet, tests were run at different inlet air temperatures, varying over a range of 60 F to 90 F. In order to accomplish this, the large room in which the test booth was erected was heated or cooled to a temperature approximating the desired inlet air temperature, and the convector was allowed to establish the temperature conditions in the booth necessary for thermal equilibrium.

No test observations were made until conditions had remained constant for several hours, as indicated by readings of all thermocouples and thermometers. When the required thermal constancy had been attained, the condensate was weighed over the period of one hour, and no test was accepted if the condensate showed more than 2½ per cent deviation in the successive 10-min increments of weight. At the end of each test, a separate test was run to determine the condensation in the piping alone, and the total condensate was corrected by subtracting the amount so determined.

## Results of Tests

The results of the tests are shown as full line curves in Figs. 2 to 7. These curves indicate the mean trend

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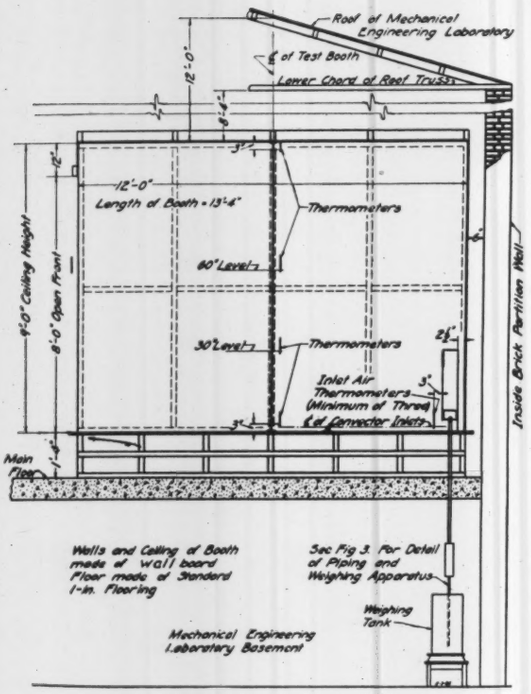
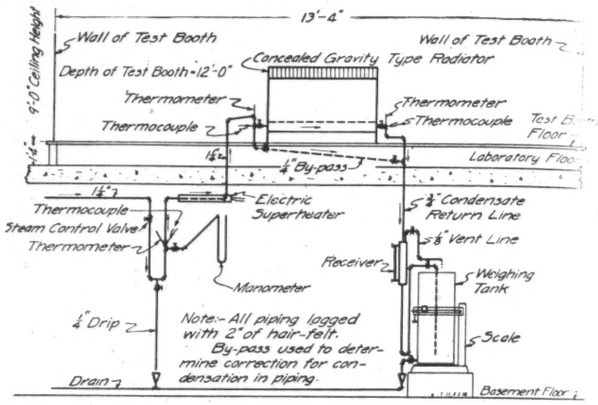



*A*—Section of warm wall test booth




*B*—Detail of piping for warm wall test booth

**Fig. 1—Warm wall test booth used in study of performance of convectors**

of the points representing the individual tests. The differences in temperature between the steam in the heating unit and the air at the inlet of the enclosure have been used as an abscissæ for all curves, but since the tests were all run with a steam temperature of 216.5 F, the abscissæ are also representative of the temperature of the air at inlet, and the latter may be obtained by subtracting any given temperature difference from 216.5 F.

In order to determine the probable deviation of the corrected heat outputs, resulting from the use of the correction factor as provided for in the A. S. H. V. E. Standard Code for Testing and Rating Concealed Gravity Type Radiation (Steam Code)[2] from the values that would have been obtained by actual tests at various temperature ranges between steam and inlet air, the calculated curves, shown as broken lines, have been superimposed on the test curves in Figs. 2 to 7. These calculated curves are defined by the equation:

$$H = a^{H}150 \left[ \frac{t_s - t_i}{150} \right]^{1.3}$$

*where* $H$ = the calculated heat output at any temperature difference between steam and inlet air, Btu per hour.

$a^{H}150$ = the actual heat output read from the test curve at a temperature difference of 150 F, Btu per hour.

$t_s$ = the steam temperature for which $H$ is to be calculated, deg F.

$t_i$ = the inlet air temperature for which $H$ is to be calculated.

Since the standard temperature difference was defined as from 215 F to 65 F, or 150 F, both the actual and the calculated curves have been made coincident at the heat output corresponding to a temperature difference of 150 F, and the difference between these curves at any given temperature range represents the error in the application of the correction factor to test results obtained with that temperature difference. In all cases the deviation, or per cent error, in the application of the correction factor at the lower limiting value of the temperature of the inlet air, or 60 F, as specified in the A. S. H. V. E. Standard Code for Testing and Rating Concealed Gravity Type Radiation (Steam Code),[2] was negligible, and the discussion has been confined to the higher limiting value or 80 F. The latter corresponds to a temperature difference of 135 F.

**Table 1—Deviation of Calculated Correction from Test Curve**

| Fig. No. | Convector No. | Type of Heating Unit | Overall Dimensions of Convector, Inches | | | Height of Heating Unit, Inches | 60 F Inlet | | | | 80 F Inlet | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Length | Height | Width | | Heat Output Btu per Hour | | 100 x Ratio $\frac{c^{H}155}{a^{H}155}$ | Per Cent Difference | Heat Output Btu per Hour | | 100 x Ratio $\frac{c^{H}135}{a^{H}135}$ | Per Cent Difference |
| | | | | | | | By Test $a^{H}155$ | Calculated $c^{H}155$ | | | By Test $a^{H}135$ | Calculated $c^{H}135$ | | |
| 4 | * 5 | Non-ferrous | 36 | 18 | 5 1/2 | 2 | 5575 | 5515 | 98.9 | −1.1 | 4410 | 4605 | 104.4 | +4.4 |
| 4 | * 6 | Non-ferrous | 30 | 28 | 5 1/2 | 2 | 6225 | 6195 | 99.6 | −0.4 | 5065 | 5175 | 102.2 | +2.2 |
| 4 | 17 | Non-ferrous | 26 | 66 | 5 1/2 | 2 | 6890 | 6885 | 99.9 | −0.1 | 5725 | 5755 | 100.5 | +0.5 |
| 2 | 19 | Non-ferrous | 29 | 18 | 5 3/8 | 5 | 3895 | 3900 | 100.1 | +0.1 | 3260 | 3255 | 99.9 | −0.1 |
| 2 | 11 | Non-ferrous | 29 | 29 | 5 3/8 | 5 | 4975 | 4970 | 99.9 | −0.1 | 4115 | 4150 | 100.8 | +0.8 |
| 2 | 16 | Non-ferrous | 29 | 67 | 5 3/8 | 5 | 6680 | 6670 | 99.9 | −0.1 | 5510 | 5570 | 101.0 | +1.0 |
| 3 | * 1 | Cast Iron | 37 1/2 | 26 | 5 1/2 | 14 3/16 | 6270 | 6275 | 100.1 | +0.1 | 5260 | 5245 | 99.7 | −0.3 |
| 3 | *13 | Cast Iron | 37 1/2 | 26 | 4 1/2 | 14 3/16 | 5680 | 5670 | 99.8 | −0.2 | 4700 | 4740 | 100.8 | +0.8 |
| 3 | 18 | Cast Iron | 38 | 70 | 5 3/4 | 14 3/16 | 8270 | 8230 | 99.5 | −0.5 | 6775 | 6880 | 101.6 | +1.6 |
| 6 | 23 | Non-ferrous | 30 | 28 1/2 | 10 7/8 | 2 | 10470 | 10450 | 99.8 | −0.2 | 8655 | 8730 | 100.9 | +0.9 |
| 5 | 21 | Non-ferrous | 20 | 24 | 4 1/4 | 4 | 3695 | 3655 | 98.9 | −1.1 | 2910 | 3050 | 104.8 | +4.8 |
| 5 | 22 | Non-ferrous | 32 | 24 | 4 1/4 | 4 | 6125 | 6060 | 99.0 | −1.0 | 4870 | 5070 | 104.1 | +4.1 |
| 7 | 20 | Non-ferrous | 21 1/2 | 29 | 11 | 5 | 5390 | 5350 | 99.3 | −0.7 | 4315 | 4465 | 103.5 | +3.5 |
| — | * 2 | Non-ferrous | 31 | 30 3/8 | 5 | 6 | 5830 | 5810 | 99.7 | −0.3 | 4820 | 4860 | 100.8 | +0.8 |
| — | * 3 | Non-ferrous | 21 | 30 3/8 | 7 1/2 | 6 | 5200 | 5185 | 99.7 | −0.3 | 4310 | 4340 | 100.7 | +0.7 |
| — | * 7 | Bimetallic | 22 5/8 | 28 3/8 | 6 1/16 | 20 | 6780 | 6805 | 100.4 | +0.4 | 5740 | 5695 | 99.2 | −0.8 |

*Presented in previous paper, Tests of Convectors in a Warm Wall Testing Booth, A. S. H. V. E. Journal Section, *Heating, Piping and Air Conditioning*, July, 1932, pp. 502-508.

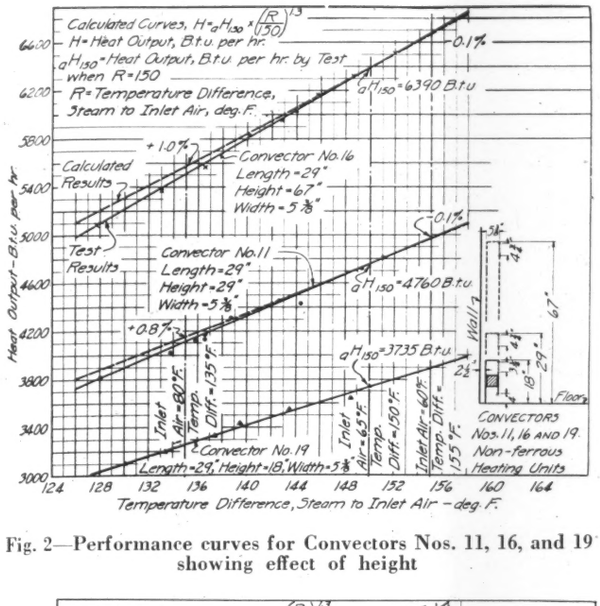



Fig. 2—**Performance curves for Convectors Nos. 11, 16, and 19 showing effect of height**

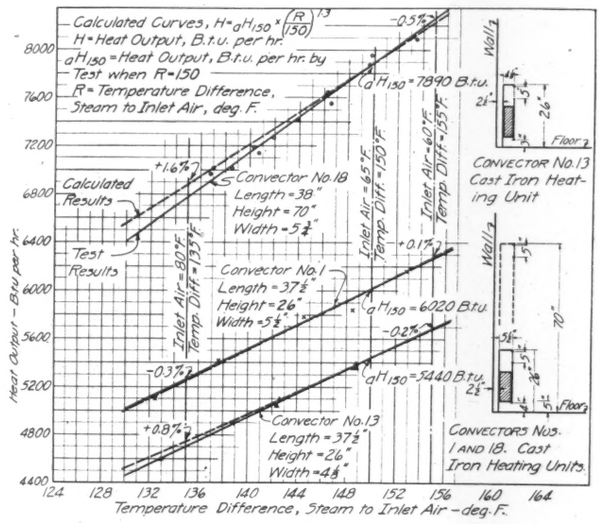



Fig. 3—**Performance curves for Convectors Nos. 1, 13, and 18 showing effect of height**

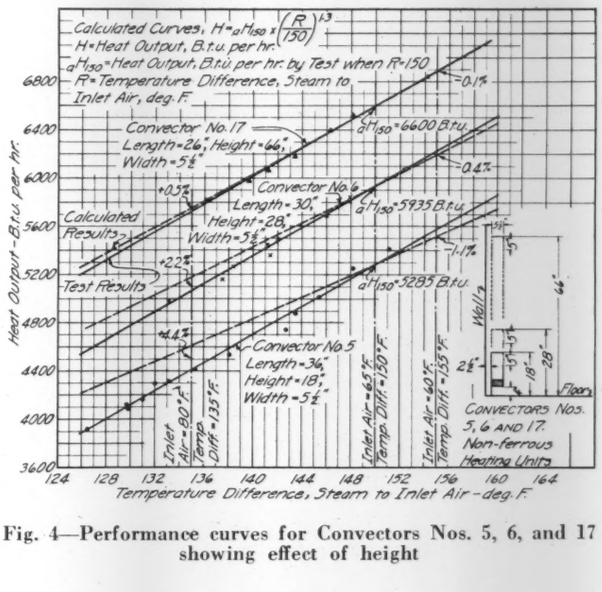



Fig. 4—**Performance curves for Convectors Nos. 5, 6, and 17 showing effect of height**

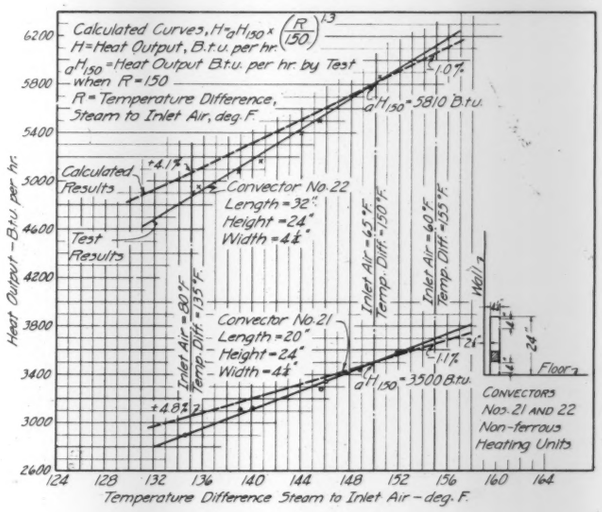



Fig. 5—**Performance curves for Convectors Nos. 21 and 22 showing effect of length**

The effect of varying the height of the cabinet is shown in Figs. 2, 3, and 4. For Fig. 2, tests were run on heating units having the same length and width with three different heights of cabinets, and for Fig. 3 on heating units having the same length and width with two different heights of cabinets. For these two types of convectors it is apparent that as the height of cabinet was increased the deviation between the actual and calculated heat outputs for a temperature range of 135 F, or the error in using the correction factor also increased. For Fig. 4 tests were run with three different heights of cabinets on the same type of convector having heating units of the same width but of slightly different lengths. The effect of length, however, is small, as shown in Fig. 5, and if anything would tend to increase the deviations shown by the lower cabinets in Fig. 4 if the same lengths had been used. Hence, results shown in Fig. 4 are representative of the nature of the effect of height and approximately representative of the magnitude. In this case the error in the use of the correction factor decreased as the height of cabinet was increased. Apparently, therefore, the height of the cabinet has some influence on the accuracy with which the correction factor may be applied, but the type of heating unit determines whether the error increases or decreases with an increase in the height of the cabinet. In any case, the total error did not exceed 4.5 per cent. It may be noted that the error in the use of the correction factor increased as the height of the cabinet was increased for the two types of convectors in which the height of the heating unit was comparatively large relative to the width, and decreased as the height of the cabinet was increased for the type of convector in which the height of the heating unit was comparatively small relative to the width. This fact may be significant, but the amount of data is hardly sufficient to warrant drawing a general conclusion.

The effect of the length of the convector for cabinets of the same height and heating units of the same width is shown in Fig. 5. As the length was increased from 20 in. to 32 in., the error in the application of the correction factor decreased from 4.8 per cent to 4.1 per

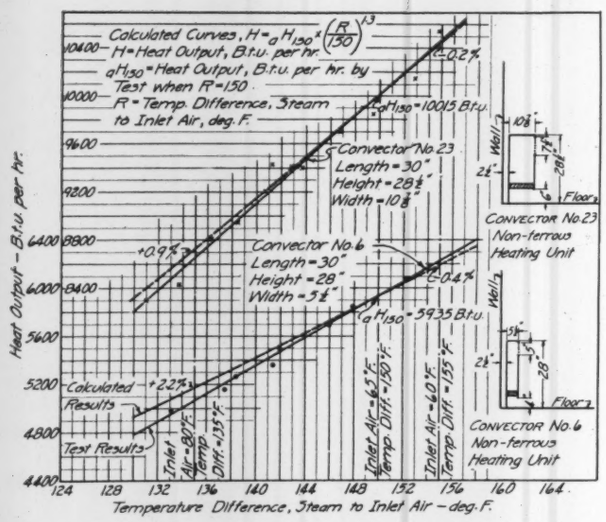

Calculated Curves, H = qH150 × (R/150)^1.3
H = Heat Output, B.t.u. per hr.
qH150 = Heat Output, B.t.u. per hr. by Test when R = 150
R = Temp. Difference, Steam to Inlet Air, deg. F.
Convector No. 23
Length = 30"
Height = 28⅛"
Width = 10⅛"
qH150 = 10015 B.t.u.
+0.2%
Convector No. 6
Length = 30"
Height = 28"
Width = 5⅛"
+0.9%
-0.4%
qH150 = 5935 B.t.u.
Calculated Results
+2.2%
Test Results
Inlet Air = 80° F. Temp. Diff. = 135° F.
Inlet Air = 63° F. Temp. Diff. = 150° F.
Inlet Air = 60° F. Temp. Diff. = 155° F.
Heat Output - B.t.u. per hr.
Temperature Difference, Steam to Inlet Air - deg. F.
Wall
Floor
Convector No. 23 Non-ferrous Heating Unit
Convector No. 6 Non-ferrous Heating Unit

**Fig. 6—Performance curves for Convectors Nos. 6 and 23 showing effect of width**

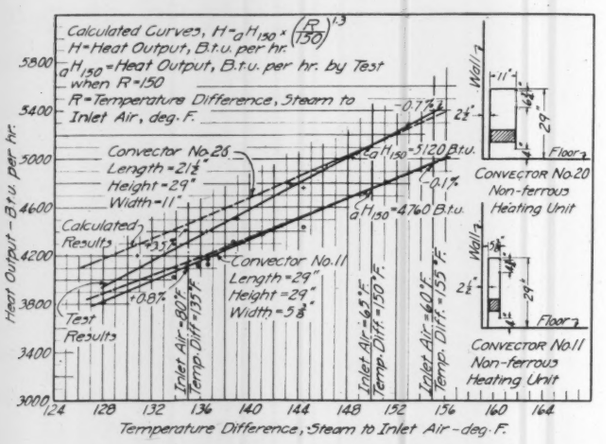

Calculated Curves, H = qH150 × (R/150)^1.3
H = Heat Output, B.t.u. per hr.
qH150 = Heat Output, B.t.u. per hr. by Test when R = 150
R = Temperature Difference, Steam to Inlet Air, deg. F.
Convector No. 28
Length = 21⅛"
Height = 29"
Width = 11"
qH150 = 5120 B.t.u.
-0.7%
-0.1%
Calculated Results
+3.3%
Convector No. 11
Length = 29"
Height = 29"
Width = 5⅛"
qH150 = 4760 B.t.u.
+0.8%
Test Results
Inlet Air = 80° F. Temp. Diff. = 135° F.
Inlet Air = 65° F. Temp. Diff. = 150° F.
Inlet Air = 60° F. Temp. Diff. = 155° F.
Heat Output - B.t.u. per hr.
Temperature Difference, Steam to Inlet Air - deg. F.
Wall
Floor
Convector No. 20 Non-ferrous Heating Unit
Convector No. 11 Non-ferrous Heating Unit

**Fig. 7—Performance curves for Convectors Nos. 11 and 20 showing effect of width**

cent. Hence, it is evident that the length had very slight influence on the error. This type of convector showed the greatest uncertainty in the application of the correction factor of all the convectors tested. The maximum error, however, did not exceed 5 per cent.

The effect of the width of the heating unit is shown in the two lower curves in Fig. 3 and in Figs. 6 and 7. For the types of convectors shown in Figs. 3 and 6 the error in the application of the correction factor decreased as the width of the heating unit was increased, while for the type shown in Fig. 7 the reverse was true. The width apparently has some influence on the error, but the nature of the influence is dependent on the type of convector.

The error in the application of the correction factor for all of the types of convectors tested and reported on in this paper and the previous[1] paper, for both 60 F and 80 F inlet air temperatures is shown in Table 1. In the majority of cases the error was of the order of one per cent. This error was influenced by both the type and the physical dimensions of the convector, and the exact nature of the influence was uncertain and difficult to predict. The error did not exceed 5 per cent, however, for any of the convectors tested.

In the case of tests run with an inlet air temperature of 80 F, or the upper limit of tolerance specified in the Code, the curves show that the actual application of the correction factor to the test results would, in practically every case, have given a calculated equivalent heat output, or rating, less than the actual heat output that would have been obtained if the test had been run with steam in the radiator at 215 F and the inlet air temperature at 65 F. That is, the correction would result in safe rating for the convector. If this upper limit of tolerance for the inlet air temperature were reduced to 75 F, the maximum probable error in the application of the correction factor would be reduced to approximately 3 per cent, instead of the probable maximum of 5 per cent existing with the present upper limit of tolerance of 80 F.

In the case of tests run with an inlet air temperature of 60 F, or the lower limit of tolerance, the actual application of the correction factor to the test results would result in a rating slightly higher than the actual performance of the convector with steam at 215 F and inlet air at 65 F. Since the maximum error would not exceed approximately one per cent, however, this slight over-rating would not be serious, and the lower limit of tolerance may be regarded as satisfactory.

## Conclusions

The following conclusions may be drawn from all of the test results, and they supersede those given in the previous paper[1]:

(1) The error in the application of the correction factor specified in the A. S. H. V. E. Standard Code for Testing and Rating Concealed Gravity Type Radiation (Steam Code),[2] probably does not exceed 5 per cent when the temperature of the inlet air on the test is not more than 15 F above or 5 F below the 65 F adopted as a standard.

(2) The magnitude of the error is influenced by the type and physical dimensions of the convector. The exact nature of this error is uncertain, and it is difficult to predict whether it will increase or decrease when the dimensions of the convector increase or decrease.

(3) In the case of tests run with inlet air temperatures higher than 65 F, the application of the correction factor to the test data practically always results in a rating somewhat lower than that which would have been obtained if the test had actually been run with an inlet air temperature of 65 F.

(4) Lowering the present specified upper limit of tolerance for the inlet air temperature, or 80 F, to one of 75 F would reduce the error in the application of the correction factor to tests run with inlet air temperatures greater than 65 F from a probable maximum of 5 per cent to one of approximately 3 per cent. Such a restriction is certainly to be recommended.

(5) In the case of tests run with inlet air temperatures between 60 and 65 F, the application of the correction factor practically always results in a rating slightly higher than the actual performance of the convector. Such overrating does not exceed approximately one per cent, and the lower limit of tolerance of 60 F, as now specified, may be regarded as satisfactory.

## Bibliography

[1] A. S. H. V. E. Research paper entitled Tests of Convectors in a Warm Wall Testing Booth, by A. P. Kratz, M. K. Fahnestock, and E. L. Broderick. A. S. H. V. E. JOURNAL SECTION, *Heating, Piping and Air Conditioning*, July, 1932, p. 502.

[2] A. S. H. V. E. Standard Code for Testing and Rating Concealed Gravity Type Radiation (Steam Code). A. S. H. V. E. JOURNAL SECTION, *Heating, Piping and Air Conditioning*, August, 1931, p. 695.

# Proceedings of the Semi-Annual Meeting

**Detroit, Mich.** **1933** **Hotel Statler**

## AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

WITH the best attendance in 4 years, the Society held its Semi-Annual Meeting at the Hotel Statler, Detroit, June 22-24, approved the submission of two codes to the membership and discussed a series of interesting papers during the three technical sessions. A well balanced program was provided and the entertainment planned and carried out by the Michigan Chapter members satisfied every taste.

The General Chairman was L. L. McConachie and H. E. Paetz was Vice-Chairman. Members of the Committee on Arrangements were J. F. Johnston, Jr., Representative of Western Michigan Chapter, and E. H. Clark, chairman, Finance Committee; R. K. Milward, chairman, Reception Committee; E. E. Dubry, chairman, Registration Committee; J. L. Fuller, chairman, Transportation Committee; Tom Brown, chairman, Entertainment Committee; R. F. Connell, chairman, Banquet Committee; G. D. Winans, chairman, Publicity Committee; and W. G. Boales, chairman, Ladies Committee.

### FIRST SESSION—Thursday, June 23, 1933
### 9:30 a. m.

President Jones announced that the Society was now functioning under the new Constitution, By-Laws and Rules, adopted by letter ballot of the members April 3, 1933.

The first speaker, Prof. G. L. Larson of the University of Wisconsin, was introduced by President Jones and his paper gave results of many observations in college buildings where large crowds assemble. This paper entitled, Temperature Gradient Observations in a Large Heated Space by G. L. Larson, D. W. Nelson and O. C. Cromer is to be published in *Heating, Piping and Air Conditioning,* September, 1933.

Discussions were presented by E. K. Campbell, W. W. Timmis and E. C. Evans. All of the questions asked were answered by the author, Professor Larson.

A paper from the Society's Research Laboratory at Pittsburgh summarizes the results of investigations recently carried on in which analysis was made of $CO_2$ method and other methods of measuring air change and air distribution. This paper entitled Indices of Air Change and Air Distribution by F. C. Houghten and J. L. Blackshaw (published in *Heating, Piping and Air Conditioning,* June, 1933, page 324), was presented by Director F. C. Houghten. Discussions were given by A. P. Kratz, J. N. Hadjisky and E. K. Campbell.

S. R. Lewis, consulting engineer, Chicago, was introduced and presented his paper entitled Testing and Rating of Air Cleaning Devices Used for General Ventilation Work (published in *Heating, Piping and Air Conditioning,* May 1933, page 275). In his summary the author told of the application of the method described in the recently prepared Code for Testing and Rating Air Cleaning Devices and explained that it had been used in hundreds of tests of various types of filters.

President Jones introduced H. C. Murphy, Chairman of the Committee on Atmospheric Dust and Air Cleaning Devices, who presented the preliminary draft of the Code for Testing and Rating Air Cleaning Devices used in General Ventilation Work.

Comprehensive discussions on the subject were given by Otto Wechsberg, Games Slayter, S. R. Lewis, Dr. L. Greenberg, and Prof. F. B. Rowley. A written discussion from Frank Thornton Jr., suggested more detailed specifications for "standard dust." After a lengthy discussion on the subject, it was moved and seconded that the Code prepared by the Committee be adopted as amended and submitted to the membership for approval by letter ballot.

On motion of Mr. Murphy, seconded by Mr. Hale, it was

VOTED: That the Committee's report be accepted and that the Code be adopted in its present form with the understanding that changes noted and briefly mentioned, will be included and the Committee be continued for further consideration and similar subjects.

On motion of Mr. Murphy, seconded by Prof. Rowley, it was

VOTED: That a Committee be appointed to cooperate with other interested agencies in endorsing the use of public funds to the extent provided in Section 202 of the National Industrial Recovery Act as outlined above.

R. H. Carpenter presented a resolution from the New York Chapter relating to the proposed program of business revival and suggested the appointment of a Society Committee to cooperate with other organizations of engineers, architects and others in furthering the reconstruction program. These ideas were presented in the form of resolutions prepared by the Committee of the New York Chapter consisting of Perry West, A. F. Hinrichsen and S. A. S. Patorno.

On motion of Mr. Carpenter, seconded by Mr. Howatt, it was

VOTED: That these resolutions be referred to the Advisory Council.

The motion was unanimously adopted.

W. W. Timmis reported on the progress of the work of the Committee on Corrosion of the *New York Real Estate Board* with which the Society is cooperating.

A message of greetings from the *American Oil Burner Association* was received from Pres. Morgan J. Hammers.

Announcements about the entertainment program were made by the General Chairman and members of the Arrangements Committee.

## SECOND SESSION—Friday, June 23, 1933
## 9:30 a. m.

President Jones called the second session to order and introduced L. A. Cherry, Buffalo, N. Y., who described, A Pipe Sizer for Determining the Sizes of Pipes and of Restricting Orifices in a Hot-Water Heating System (published in *Heating, Piping and Air Conditioning,* July 1933, page 381). The author outlined his method of applying the data developed by Prof. F. E. Giesecke. In the discussion, comments were made by Prof. Giesecke, R. E. Moore, R. C. Bolsinger and L. W. Moon.

With Vice-President John Howatt in the Chair, Prof. A. P. Kratz presented the paper, The Application of the Eupatheoscope for Measuring the Performance of Direct Radiators and Convectors in Terms of Equivalent Temperature by A. C. Willard, A. P. Kratz and M. K. Fahnestock (published in *Heating, Piping and Air Conditioning,* July 1933, page 369). This work carried on at the University of Illinois in cooperation with the Research Laboratory of the A. S. H. V. E. brought out eight conclusive results, among which were the facts that the eupatheoscope affords a means of evaluating the combined effect of radiation and convection in a given environment in terms of a standard environment and in some terms relating to human comfort, also, that the readings of this instrument serve as a means of rating various heating units in the order of the relative heating effects produced.

Discussions were offered by Prof. C.-E. A. Winslow, H. F. Hutzel and E. H. Beling.

A second report on the cooperative research work sponsored by Prof. Kratz, summarizes the paper Tests of Convectors in a Warm Wall Testing Booth by A. P. Kratz, M. K. Fahnestock and E. L. Broderick (published in *Heating, Piping and Air Conditioning,* August 1933, page 431). The discussion was participated in by E. H. Beling, Prof. F. B. Rowley and R. C. Bolsinger.

President Jones presented R. N. Trane, Chairman of the Committee on Code for Testing and Rating Convectors, who presented the Committee's report which covered the Hot Water Section of the Code. Prepared discussions by F. D. Mensing, Prof. E. G. Smith and F. W. Hvoslef were presented. Comments were made by S. R. Lewis, M. G. Steele, Prof. A. P. Kratz and Prof. F. B. Rowley.

On motion of Prof. Giesecke, seconded by Mr. Cassell, it was

VOTED: That the report of the Committee be accepted as amended and submitted to the Society for adoption by letter ballot. Also, that the Committee be continued.

This motion was carried unanimously.

Pres. W. T. Jones announced that ten past presidents of the Society were in attendance and he expressed his gratification on being able to introduce Dean Anderson, W. H. Driscoll, John F. Hale, L. A. Harding, E. Vernon Hill, S. R. Lewis, J. I. Lyle, J. R. McColl, F. B. Rowley and F. R. Still.

President Jones introduced P. M. O'Connell, President of the Pacific Northwest Chapter, who held the long distance record for travel to the meeting.

## THIRD SESSION—Saturday, June 24, 1933
## 9:30 a. m.

The third session of the Semi-Annual Meeting was opened by President Jones who introduced Prof. F. B. Rowley of the University of Minnesota, whose subject was The Heat Conductivity of Wood at Climatic Temperature Differences (published in *Heating, Piping and Air Conditioning,* June 1933, page 313). The report of this work covered cooperative research carried on at the University of Minnesota in cooperation with the *National Lumber Manufacturers Association* and the Research Laboratory of the A. S. H. V. E.

A written discussion was offered by E. R. Queer, of the Engineering Experiment Station, Pennsylvania State College, and some comments were made by E. C. Rack, New York.

President Jones introduced Prof. C. P. Yaglou, Harvard School of Public Health, who briefly presented an abstract of the paper entitled, Physiologic Changes During Exposure to Ionized Air by C. P. Yaglou, A. D. Brandt and L. C. Benjamin (published in *Heating, Piping and Air Conditioning,* August 1933, page 423). Comments on this research carried on in cooperation with the Society's Research Laboratory, were made by J. N. Hadjisky and Dr. C.-E. A. Winslow. Dean F. Paul Anderson described some studies being carried on at the University of Kentucky to relieve hay fever sufferers and told of the results obtained where filtered air was used.

W. H. Driscoll reported on the conference held during the previous afternoon to discuss the elimination of the term square foot. He presented a resolution from the Committee on Nomenclature and moved its adoption:

That this Society go on record as accepting 1000 Btu as the commercial unit of heat quantity and that it adopt the symbol *Mb* as the symbol of same and further that it adopt the symbol *Mbh* as an indication of the rate of heat flow per hour.

The motion was seconded and carried.

Ray C. Spitzley, Past President of the *Heating and Piping Contractors National Association* was introduced by President Jones and gave a few words of greetings from the Association.

With first Vice President C. V. Haynes presiding, Prof. L. E. Davies of Armour Institute of Technology presented a report on the cooperative research sponsored by the Society's Research Laboratory and the *Chicago Ventilating Contractors Association.* Those who discussed the report were John Howatt, J. H. Van Alsburg, W. W. Timmis and E. K. Campbell.

The Resolutions Committee consisting of J. F. Hale, Chairman, H. L. Alt and P. M. O'Connell rendered its report, Mr. Alt making the presentation.

Inasmuch as one of the most successful meetings is now drawing toward a close be it hereby

RESOLVED, that the Michigan Chapter should be highly commended for their courage in undertaking the responsibility for a meeting at this time and under the present conditions; and be it further RESOLVED, that admiration be expressed for the efficient functioning of the various committees in providing such pleasing places of assembly, wonderful entertainments and the

very efficient method of transportation, not forgetting the graceful services rendered to the ladies.

RESOLVED, that it is the sense of this meeting that the hotel management should be commended for the excellent accommodations provided and the service they have rendered during the sojourn with them, also the local Press for the recognition given to the convention.

RESOLVED, that praise be expressed to the Program Committee for their excellent selection of papers presented at the technical sessions.

The resolutions were unanimously adopted.

W. R. Eichberg reported for the Nominating Committee, who announced the selections for Officers and Members of the Council who will serve in 1934.

President Jones introduced J. L. Blackshaw, member of the staff at the Research Laboratory, who made the presentation of the paper Carbon Monoxide Distribution in Relation to the Heating and Ventilating of a One-Floor Garage by F. C. Houghten and Paul McDermott, (published in *Heating, Piping and Air Conditioning*, July 1933, page 376). In the discussion, comments were offered by E. H. Beling and E. K. Campbell and the questions asked were answered by Mr. Blackshaw.

The meeting adjourned at 11:45 a. m.

## Council Meeting at Detroit

After dinner on Wednesday, June 21, Pres. W. T. Jones called the regular meeting of the Council to order at the Hotel Statler, Detroit, Mich., with the following present: D. S. Boyden, Boston, Mass.; E. K. Campbell, Kansas City, Mo.; R. H. Carpenter, New York; J. D. Cassell, Philadelphia, Pa.; Prof. F. E. Giesecke, College Station, Texas; C. V. Haynes, Ardmore, Pa.; John Howatt, Chicago, Ill.; Prof. G. L. Larson, Madison, Wis.; J. F. McIntire, Detroit, Mich.; L. W. Moon, St. Louis, Mo.; Prof. F. B. Rowley, Minneapolis, Minn.; W. E. Stark, Cleveland, Ohio; W. R. Eichberg, Philadelphia, Pa. and A. V. Hutchinson, New York.

Nomination of five members to serve for a three-year term on the Committee on Research, was made as required by ARTICLE B-VIII *Section* 8 of the By-Laws. The members nominated for the term beginning in 1934 are: C. A. Booth, Buffalo, E. K. Campbell, Kansas City, John Howatt, Chicago, A. J. Nesbitt, Philadelphia, and J. H. Walker, Detroit.

The dates selected for the 40th Annual Meeting are February 5 to 8 with N. Y. Chapter as hosts and it was the decision of the Council that the Semi-Annual Meeting 1934 will be held under the auspices of the Philadelphia Chapter.

Suggestions for Changes in the Constitution, By-Laws and Rules were referred to the Committee on Revision of Constitution and By-Laws.

Favorable action on two applications for reinstatement was taken and the resignations of 48 members were accepted.

New members elected between July 1 and October 1 will pay $9 dues and those who affiliate after October 1 will be charged $4.50 dues for 1933.

Revised rates for Guide advertising in the 1934 edition were approved and resolutions of appreciation were adopted for the cooperation given by the *American Oil Burner Association* and the *American Society for Testing Materials*.

## Membership and Chapter Conference

A joint meeting of the Membership Committee and the Chapter Relations Committee was held on June 22, at 1:00 o'clock in the Hotel Statler, Detroit, and was attended by the following Chapter Representatives, with E. K. Campbell, chairman of both committees, presiding; L. W. Moon, St. Louis; P. M. O'Connell, Pacific Northwest; J. H. Van Alsburg, Western Michigan; M. C. Beman, Western New York; J. J. Hayes, Illinois; W. W. Timmis, New York; W. E. Stark, Cleveland; C. H. Randolph and Ernest Szekely, Wisconsin; and E. K. Campbell, Kansas City.

Chapter Relations work was discussed and it was planned to send detailed suggestions to the chairman of the Program Committee of each chapter.

Everyone agreed that the success of the membership work is extremely important and that a definite program should be planned, based on the thought that the fall is the time when greatest activity should be made to secure new members.

The program outlined is:

1. Each chapter through its membership chairman shall prepare and send to the general membership chairman a list of prospective members containing at least three times as many as the quota of the chapter, making an effort to list the best qualified prospects.
2. The Membership Committee of the Council will render assistance by writing to prospective members when especially requested and, in some cases, a letter may be sent by the President of the Society.
3. It was also decided to approve the plan of the Minnesota Chapter by which the Chapter was divided into two teams for a membership contest, the losing team to provide the entertainment for a chapter meeting.

It is hoped by the committee that this plan may enable Chapters to have a large part of their membership actively interested in securing new members and that the loss in number may be off-set by the gain from such a program.

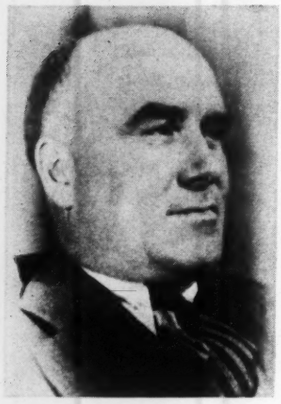
## New Terms Approved

At the Annual Meeting of the Society in Cincinnati, O., Pres. W. T. Jones appointed a Committee on Nomenclature to study the possibility of eliminating the term "square foot" and under the leadership of S. R. Lewis, Chicago, assisted by W. H. Carrier, P. D. Close, W. H. Driscoll, L. A. Harding, D. D. Kimball, J. R. McColl, C. L. Riley, W. A. Rowe, Perry West and A. C. Willard, several months were devoted to an exchange of views and the suggestion of terms that might be appropriate, practical, and acceptable.

In order to get the ideas of other organizations 18 allied groups were invited to participate in a Discussion of Nomenclature during the Semi-Annual Meeting of the Society at Hotel Statler, Detroit. The conference was held on Friday afternoon, June 23, and a most interesting discussion developed among the men in attendance.

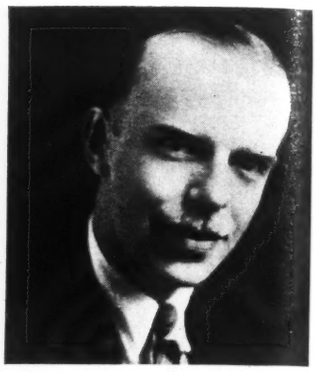
At the suggestion of Dean F. Paul Anderson it was voted, "that the commercial unit of heat quantity shall be 1000 Btu." This, it was explained, is to supersede the term square foot and the steam and water units commercially used, 240 Btu and 150 Btu respectively.

**R. K. Milward**
*Reception*

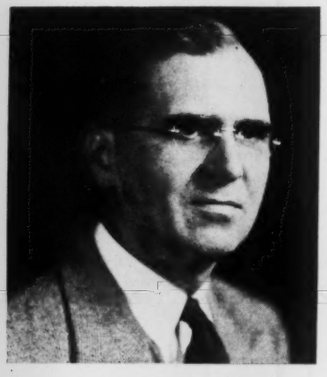


**L. L. McConachie**
*General Chairman*

**H. E. Paetz**
*Vice-Chairman*



**Tom Brown**
*Entertainment*

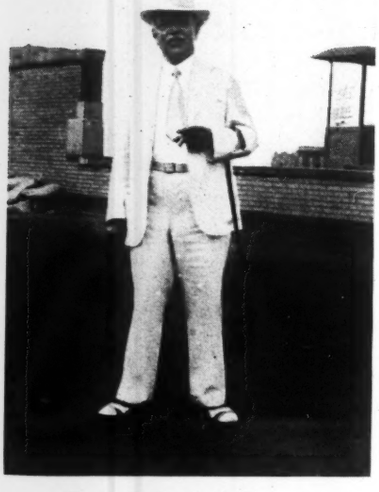


**E. E. Dubry**
*Registration*

**W. H. Driscoll, W. T. Jones**
*and The President's Lincoln*

**J. L. Fuller**
*Transportation*

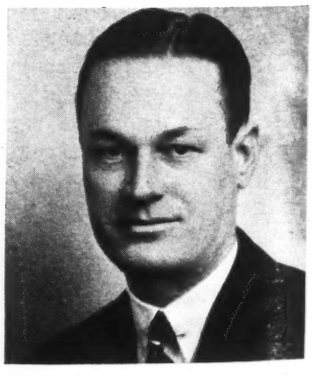
**W. G. Boales**
*Ladies*



**Dean F. Paul Anderson**
*Toastmaster at the Semi-Annual Banquet*

**G. D. Winans**
*Publicity*

**R. F. Connell**
*Banquet*



**E. H. Clark**
*Finance*

During an extended and spirited discussion the following terms were considered:

*Therm.*—This is 1000 Btu in common use in America but it means 100,000 Btu in Great Britain. This was deemed a sufficient reason for rejecting the term therm.

*Kb.*—This was recommended by the Power Code Committee of the *American Society of Mechanical Engineers* but was not acceptable to many of the men in attendance at the meeting, since *K* in structural engineering is used to signify 1000 lb and there might be confusion.

*M. Btu*—This was recommended by a number of the delegates as being self indicating as to its meaning.

Many other symbols were proposed and finally, on motion of W. H. Driscoll, by practically unanimous vote, it was decided that:

*Mb* shall be the symbol of 1000 Btu heat quantity.

*Mbh* shall be the symbol of 1000 Btu per hour.

The Chairman of the Society's Committee on Nomenclature, S. R. Lewis, expressed the opinion that repetition of these interesting and informal discussions on nomenclature might profitably be held at future annual and semi-annual meetings of the Society and the audience agreed with his proposal that such meetings be held.

Each of the cooperative organizations will be requested to accept and adopt the new unit and symbol as soon as expedient both in the daily practice of its members and in its literature.

The aim of future conferences will be to improve engineering nomenclature and through cooperative measures establish and develop uniform standards under the procedure of A. S. A.

Those who registered were: F. Paul Anderson, Lexington, Ky.; J. J. Aeberly, Chicago, Ill.; M. T. Branche, Toledo, O.; R. H. Carpenter, New York, N. Y.; P. D. Close, Chicago, Ill.; S. H. Downs, Kalamazoo, Mich.; W. H. Driscoll, New York, N. Y.; F. E. Giesecke, College Station, Tex.; J. N. Hadjisky, Detroit, Mich.; L. A. Harding, Buffalo, N. Y.; E. E. Harris, Detroit, Mich.; J. J. Hayes, Chicago, Ill.; C. H. B. Hotchkiss, New York, N. Y.; John Howatt, Chicago, Ill.; I. C. Jennings, Norwalk, Conn.; H. B. Johns, Chicago, Ill.; F. A. Kitchen, Cleveland, O.; A. E. Knibb, Detroit, Mich.; G. L. Larson, Madison, Wis.; S. R. Lewis, Chicago, Ill.; F. J. Linsenmeyer, Detroit, Mich.; P. S. Lyon, New York, N. Y.; J. R. McColl, Detroit, Mich.; E. D. Milener, New York, N. Y.; V. D. Milliken, St. Joseph, Mich.; O. J. Prentice, Chicago, Ill.; E. C. Rack, New York, N. Y.; C. H. Randolph, Milwaukee, Wis.; T. F. Rockwell, Pittsburgh, Pa.; F. B. Rowley, Minneapolis, Minn.; H. Selving, Detroit, Mich.; J. G. Shodron, Ft. Atkinson, Wis.; R. L. Spitzley, Detroit, Mich.; W. E. Stark, Cleveland, O.; W. W. Timmis, New York, N. Y.; J. H. Walker, Detroit, Mich.; R. H. Wehrle, Cleveland, O.; F. R. Wright, Cleveland, O., and Howard Wylie, Norwalk, Conn.

## Committee on Arrangements

The complete personnel of the Committee on Arrangements was:

*General Chairman*—L. L. McConachie

*Vice-Chairman*—H. E. Paetz

*Representative Western Michigan Chapter*—J. F. Johnston, Jr.

*Finance Committee:* E. H. Clark, *Chairman,* J. D. Cantwell and M. F. Mattingly.

*Reception Committee:* R. K. Milward, *Chairman,* W. G. Boales, R. F. Connell, E. E. Dubry, L. L. McConachie, W. A. Rowe, K. L. Ziesse and all hostesses.

*Registration Committee:* E. E. Dubry, *Chairman,* E. H. Clark, S. S. Sanford, J. W. Snyder and G. H. Tuttle.

*Transportation Committee:* J. L. Fuller, *Chairman,* and H. F. Reid.

*Entertainment Committee:* Tom Brown, *Chairman,* W. F. Arnoldy, E. Anderson, Lyman Phillips, E. D. Purdy and Wm. Watson.

*Banquet Committee:* R. F. Connell, *Chairman,* Harry Christenson, E. H. Clark, H. A. Hamlin, M. B. Shea and A. C. Wallich.

*Publicity Committee:* G. D. Winans, *Chairman,* J. S. Kilner and L. L. McConachie.

*Ladies Committee:* W. G. Boales, *Chairman,* F. J. Feely, *Vice-Chairman,* Mrs. W. G. Boales, Mrs. Tom Brown, Mrs. E. H. Clark, Mrs. R. F. Connell, Mrs. S. H. Downs, Mrs. E. E. Dubry, Mrs. F. G. Feely, Mrs. J. L. Fuller, Mrs. L. L. McConachie, Mrs. J. F. McIntire, Mrs. R. K. Milward, Mrs. H. E. Paetz, Mrs. J. W. Snyder, Mrs. R. L. Spitzley, Mrs. A. C. Wallich and Mrs. G. D. Winans.

## Entertainment for Everyone

The ladies assembled on the mezzanine of Hotel Statler before noon on Thursday and then enjoyed a bus ride to Dearborn Inn where a delightful luncheon was served. A number of the men joined the party which was conducted through Greenfield Village. This trip had been specially arranged for A.S.H.V.E. members and their wives through the courtesy of Henry Ford. In the group of historical buildings which he has collected there are 47 units including an Edison group containing the workshop, laboratories and many of the original instruments developed by Thomas A. Edison. The visitors found the drive around the Village in horse-drawn carriages a novel experience and there was much interest in the Village School and the General Store. At the conclusion of the trip, Chairman W. G. Boales and his assistant, F. G. Feely chaperoned their charges to Meadowbrook Country Club for the evening festivities.

Immediately after adjournment of the technical session, the members who registered for golf found cars waiting at the Hotel Statler entrance ready for a trip to Meadowbrook Country Club where a Kickers Handicap Tournament was held.

Chairman Tom Brown had arranged several special events one of which was a driving contest with prizes for the longest and shortest drives. When the tournament was finished, a buffet supper was served to the members and their wives in the dining room of the Club. Large quantities of food disappeared under the attack of well-developed appetites. After supper the 250 guests divided their time between dancing and enjoying the comfortable chairs on the cool veranda.

On Friday the ladies had luncheon at the Hotel Statler and then visited the Detroit Art Institute where N. E. Dewes of U. S. Radiator Corp. acted as guide and gave historical and interesting information about the exhibits of photographs, prints and paintings.

On Friday afternoon the Research Tournament was held at Lochmoor Country Club and at the conclusion of the 18 holes of medal play, M. B. Shea was lucky enough to win possession of the Research Cup for a year and C. V. Haynes was the winner of the Michigan

Chapter Trophy. The winners in the three classes were: *Class A,* R. E. Moore, and E. J. Anderson; *Class B,* Tom Brown and A. A. Emerick; *Class C,* G. W. F. Myers and H. E. Sproull. The golf trophies were awarded during the banquet and it was revealed that H. F. Hutzel made the longest drive, 207 yds; J. C. Matchett had the shortest drive; E. J. Anderson had the low gross score and W. A. Rowe took the most strokes. In the Kickers Handicap at Meadowbrook Country Club on Thursday the winners were G. H. Cummins, J. S. Kilner, F. X. Marzolf, J. R. McColl, Mr. McLeod, J. H. Milliken, C. E. Price, C. H. Soderberg, L. E. Walsh and K. L. Ziesse.

The scene of the Semi-Annual Banquet was a delightful spot on the shore of Lake St. Clair and Frank Connell the Chairman, was highly praised for staging this delightful affair in the Grosse Pointe Yacht Club. An excellent dinner was served promptly at 7:45 p. m. and the menu held a strong appeal as the combination of frog legs, fish and steak was irresistible.

Dean F. Paul Anderson, Past President of the Society, was Toastmaster and at the conclusion of dinner he announced that five prominent Society members had been signally honored by Governor Ruby Laffoon of Kentucky and that he was charged by the Governor to deliver commissions to Pres. W. T. Jones, W. H. Driscoll, L. A. Harding, S. R. Lewis and A. C. Willard, who had been made aides to the Governor of Kentucky with the rank of Colonel. This announcement came as a complete surprise even to those who had been made Colonels and when presented with their commissions, Colonels Jones, Driscoll, Harding and Lewis expressed their appreciation for the honor conferred by the Governor of Kentucky. The audience arose, saluted the Colonels and sang a verse of My Old Kentucky Home.

Tom Brown, Chairman of the Golf Committee, was introduced and awarded the various golf trophies to the winners of the Meadowbrook and Lochmoor Tournaments.

Pres. W. T. Jones was introduced by Dean Anderson and with a brief tribute to Prof. F. B. Rowley, past president of the Society, he presented a handsome leather bound memory book on behalf of the Council. Professor Rowley expressed his appreciation for this splendid gift which recorded many pleasant incidents during his term as President.

Dean Anderson explained to the members that a cooperative effort had been made by several past presidents of the Society to compile suitable advice to guide the President and the first victim was President Jones. Each of the newly created Colonels presented a true-to-life appearance with an upstanding mustache and a goatee of noble proportions.

Colonel S. R. Lewis was introduced and said that he did not intend to speak on the subject assigned to him but would advise President, beg pardon, Col. Jones on more serious matters and concluded his speech by proposing the disposal of all past presidents under the terms of a new expression "heve" coined by Mr. Jones.

Colonel W. H. Driscoll of New York, Montclair, N. J., and Lexington, Ky., asked the indulgence of the audience and the apologies of Edgar Allen Poe who had inspired him to write some verses, which he called The Raving.

In the first four verses President Jones learned how to balance the budget, collect dues and keep everyone satisfied and the concluding two verses offered expert advice to the Secretary on matrimonial problems.

Colonel L. A. Harding, engineer, author, traveler and radio expert, explained that having listened to Will Rogers, Ed Wynn, Ben Bernie and Baron Munchausen there was little left to tell the President, but he observed, "You can always tell a man from Boston but you can't tell him much, so far be it from me to make the attempt." He then read a "pome," ode or a dirge in appreciation of the skipper by the well known Turkish poet, Abdul Bobo Ameer. Apologies were made because the meter was slightly warped in translation.

The humorous remarks of the speakers were energetically applauded by the audience who enjoyed the quips, the verses and advice that was given by The Brains Trust to Colonel Jones.

The program was original, short and entertaining, the tempo maintained was rapid and the consensus of opinion was that Dean Anderson as toastmaster and the committee had produced a smash hit in entertainment.

Dancing to the music of Ray Gorrell's orchestra started at 10:30 p. m. and continued until the small hours. The orchestra leader sang some parodies of popular tunes, the clever verses for which came from the pen of L. L. Smith of Detroit. Between dances the wide verandas held their quota while others visited the Fo'castle.

The return to hotels and homes was handled expeditiously by the Transportation Committee in charge of John L. Fuller.

**The Art Center in Detroit**

# Air Conditioning Conference and Exhibition Great Success

A PREDICTION that air conditioning in the next 20 years will expand to as great an extent as did the automobile industry, was voiced at the Air Conditioning Symposium and Exposition held respectively at the University of Southern California in Los Angeles and the Los Angeles Chamber of Commerce in cooperation with the Southern California Chapter of the A. S. H. V. E.

An afternoon and evening meeting was held at the University on May 23 and during the five days, May 22-28, air conditioning equipment was demonstrated at the Chamber of Commerce Building, where 24 different types of apparatus were shown by the local agents and nationally known manufacturers.

For days in advance newspapers told of this exhibit and announcements were sent to more than 6,000 people in Los Angeles and the suburban area. The response from engineers, architects, building managers, industrialists and home owners was tremendous and, in a leading Los Angeles daily, Irving H. Hellman described the show in the following terms:

"The men who brought this show about in such a period of depressed business, it seems to me, were literally carrying out the President's program for business revival. I do not know what, if any, sales or dollar return they received through exhibiting, but such courage merits recognition.

"That nationally known manufacturers recognized the importance was obvious.

"The first four-cylinder superpower compressor ever shown was rushed here from the Dayton plant by the Frigidaire Corp. at an expense of several hundred dollars for transport alone.

"Westinghouse sent with its special equipment exhibit a statement by its president, predicting that air conditioning—as an industry—was not of tomorrow but today, and seemed very likely to develop a field as great as the automobile did in 20 years.

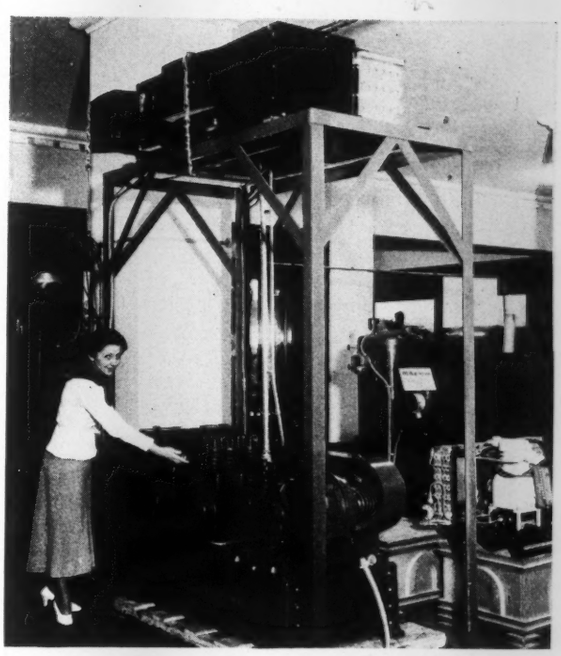
"In our own local field the engineering house of English & Lauer produced an initial showing of a machine designed and manufactured in Los Angeles. This innovation, which may revolutionize heating and ventilating processes, attracted attention because it is dually constructed to supply either heat or cold under thermostatic control, as desired.

"Another stellar exhibit was sent by the General Electric Co. from Schenectady, with several features never introduced before in the country.

"Beauty shops were given special attention. The Carrier Equipment Co. of Los Angeles showed for that purpose a compact design in radio cabinet style with air conditioning of 10,000 sq ft.

"Taken all through, this exposition was, I think, a practical demonstration that we have groups of sound-headed business men among us who are certain of early revival of business. They are surely contributing efforts and investment as if they felt every confidence. I do not know of any factory or distributor represented there, in this new industry, which had less than $100,000 invested. And each of them seemed to be planning to expand output and employment.

"It is these practical demonstrations which encourage the public. It goes to prove also that our inventors and designers are still at work and are successfully interesting manufacturers."



The following representatives and manufacturers had equipment on exhibition: Geo. Belsey Co., Carrier Engineering Corp., English & Lauer, Inc., Frigidaire Co., Gay Engineering Co., General Electric Co., Grinnell Co., Inc., Ilg Electric Ventilating Co., Master Fan Co., Andrew G. Orear, Payne Furnace Co., Sterling Electric Motors, Thermador Heater Co., Trane Co., Union Ice Co., U. S. Electric Co., Utility Fan & Mfg. Co., Westinghouse Electric & Manufacturing Co., York Ice Machinery Corp., and Young Radiator Co.

The committees that cooperated to make the meeting and show a success were the Program Committee—W. E. Barnum, *chairman;* Publicity Committee—W. W. Pierce, *chairman;* and Exposition Committee—W. Fabling, *chairman.*

Vice-Pres. W. H. C. Ness presided at the meeting because of the absence of the president, L. H. Polderman, who was confined to a Chicago hospital.

The address that Mr. Polderman intended to make was read by Mr. Ness and special appreciation was expressed for the cooperation of the Los Angeles Chamber of Commerce, the University of Southern California, the public utilities of the city and the various committees, who arranged the details of the meeting. In his statement Mr. Polderman said, "Whether your interest is academic, technical or from a manufacturing or sales viewpoint, the papers which are to be presented will be of interest."

R. L. Daugherty

E. L. Ellingwood

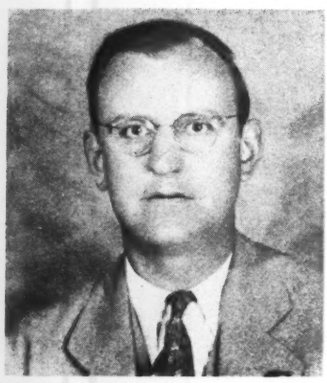
E. H. Kendall

L. H. Polderman

W. H. C. Ness

P. D. Close

W. E. Barnum



J. F. Kooistra

M. M. Lawler

The speakers were P. D. Close, New York, Technical Secretary of the A. S. H. V. E., Dr. R. L. Daugherty, of California Institute of Technology, Dr. V. O. Knudsen, of the University of Southern California, W. E. Barnum, H. H. Douglas, E. L. Ellingwood, E. H. Kendall, J. F. Kooistra, M. M. Lawler, J. C. Malm and H. L. Warren.

In concluding his statement, Mr. Polderman described the work of the A. S. H. V. E. since its organization 40 years ago, told of the functions of its local chapters and described some of the educational work carried on by the Southern California Chapter through its system of meetings and expressed the hope that every engineer engaged in heating and ventilating would affiliate with the Society.

## Kansas City

*June* 12, 1933. The annual social meeting of the Kansas City Chapter was held at Oakwood Country Club on the evening of June 12, when 75 members and guests were present and enjoyed a wonderful dinner on the open terrace. Music was furnished by Haley's orchestra, which is one of the best in the vicinity.

No business was transacted and speeches were conspicuous by their absence. Dancing on the terrace as well as bridge were enjoyed by the party, which was so successful that it was decided in the future to continue the plan of omitting business from the annual social meeting, says the report of Secy. D. D. Zink. J. M. Arthur, B. F. Natkin and L. R. Chase formed the committee responsible for the evening's entertainment.

## Wisconsin

*July* 12, 1933. A special meeting was held so that the members of the Chapter and their friends might hear R. J. Thompson, of the Kinetic Laboratories, speak on the subject of Freon.

Representatives of refrigeration firms as well as several of the city officials particularly interested in this subject were present and 24 sat down to dinner on the roof of the Shorecrest Hotel. Approximately 50 members and guests were present at 8:00 o'clock when the speaker was presented.

Mr. Thompson gave the history of Freon and told of its physical, chemical and thermo-dynamic properties, as well as conducting a number of experiments which demonstrated its non-odorous and non-toxic qualities.

Secy. C. H. Randolph states that the consensus of opinion seemed to be that the evening had been very well spent and that Mr. Thompson had given some valuable information to the Chapter members and their guests.

*June* 8, 1933. Fifty members of the Wisconsin Chapter attended the annual picnic and were present at the Chalet for a chicken dinner, which was much appreciated after an afternoon of baseball and horseshoe pitching. For a depression year, the group was most enthusiastic, according to the report of Secy. C. H. Randolph.

*May* 20, 1933. At a meeting in the Mirror Room of the Hotel Pfister, E. D. Milener, industrial research representative of the *American Gas Association*, addressed the Wisconsin Chapter and their guests on the subject of Domestic Air Conditioning.

Mr. Milener gave new ideas as to what future developments in the residential field would consist of and, with his talk, showed slides and presented data which were of considerable interest to those present.

The attendance at this meeting was the largest which the Chapter has had in the last eight years with well over a hundred members and guests present. The Chapter feels that Mr. Milener contributed to one of the most interesting evenings which they have had.

## W. H. Driscoll Returns from West Indies

W. H. Driscoll, Vice President of the Thompson-Starrett Co., New York, returned recently on the S. S. Borinquen from a 12-day business trip to Porto Rico. Immediately after the Society's Semi-Annual Meeting in Detroit he sailed from New York.

## Advisory Committee Appointed for Third Exposition

Announcement that the Third International Heating and Ventilating Exposition, will be held in Grand Central Palace, New York City, February 5 to 9, 1934, has recently been made.

The Third Exposition, like its predecessors at Cleveland in 1932 and at Philadelphia in 1930, will be held during the same week as the 40th Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS in New York. The Advisory Committee for the Exposition is: Charles V. Haynes, *Chairman;* A. A. Ahlff, A. S. Armagnac, A. L. Baum, W. H. Carrier, J. G. Eadie, P. E. Fansler, H. W. Fiedler, J. C. Fitts, Otto Goldschmidt, C. H. B. Hotchkiss, A. J. Nesbitt, A. J. Offner, W. J. Olvany, W. J. Osborn, G. E. Otis, C. R. Place, C.H. Quirk, E. C. Rack, H. T. Richardson, E. J. Ritchie, P. H. Schoepflin, N. T. Sellman, B. E. Tiltz, Warren Webster, Jr., and H. S. Wheller.

Widespread interest in the Heating and Ventilating Exposition has been indicated and results from the high numerical count of the industries which are vitally concerned with it; also from the fact that the application of heating and ventilating is of direct concern not only to those who plan and equip buildings of every type but likewise to every person who inhabits a dwelling or spends even part of his working hours indoors.

An idea of the comprehensiveness of the Exposition may be gained from the fact that it will bring together hundreds of exhibits showing the latest and best heating, ventilating and air conditioning equipment and methods; also refrigerating equipment as related to air conditioning. Included in the displays will be heaters and burners designed for gas, oil, and solid fuels; also electric heaters, fans, air filters, humidifiers, unit heaters and unit coolers. Represented also, will be those rather remarkable instruments of precision which are now installed to control and regulate temperature, pressure, volume, time, velocity, draft, and other factors involved in the problems of heating and ventilating.

Air conditioning, which had its application at first in process work where the condition of the air affected manufacturing processes and the materials being manufactured, has gradually been extended to theaters and auditoriums and, more recently, to stores, office buildings, and railroad trains.

The conduct of the Exposition and all details of exhibit arrangement will be handled by the International Exposition Co., Grand Central Palace, New York, and will be under the personal direction of Charles F. Roth, who was similarly responsible for the earlier expositions at Philadelphia and Cleveland.

## Equipment Demonstration Well Attended

At the invitation of Pres. C. T. Morse of the American Blower Corp., members of the A. S. H. V. E. were invited to attend a demonstration of air conditioning and cooling apparatus at the company's Russell Street plant at the conclusion of the Society's Semi-Annual Meeting at Hotel Statler.

At 12:30 p. m. busses carried 220 members and guests to the plant of the American Blower Corp., where a buffet luncheon was served. After luncheon guides were provided and an inspection of the plant was made and an explanation of the demonstrations was given by the engineering staff of the company. In the Experimental Laboratory the test set-up specified in the A. S. H. V. E. Standard Code for Testing Centrifugal Blowers and Disc and Propeller Fans was demonstrated and the Code set-up for testing Unit Heaters also was of interest.

# CANDIDATES FOR MEMBERSHIP

The Constitution of the Society as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When replies are received from references, the Candidate's application shall be submitted to and acted upon by the Membership Committee as soon as possible.

When the Membership Committee has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 15 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Membership Committee, and in turn the Council, urge the members to assume their share of the responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some members by August 15, 1933, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

| CANDIDATES | REFERENCES | |
|---|---|---|
| | *Proposers* | *Seconders* |
| BARNS, AMOS A., Owner and Operator, Amos A. Barns, Ithaca, New York. | E. K. Campbell | G. L. Larson |
| | S. R. Lewis | H. N. Booth |
| CORRAO, JOSEPH, Estimator and Engr., Herman Lawson Co., San Francisco, Calif. | W. E. Leland | C. R. Hunt (*Non-Member*) |
| | H. S. Haley | J. I. Krueger |
| HAMENT, LOUIS, Mgr., Aquatic Chemical & Metallurgical Engrs., New York, N. Y. | W. W. Timmis | C. R. Hiers |
| | H. W. Fiedler | |
| KWAN, IU KI, Genl. Mgr., China Engrg. Co., Shanghai, China. | N. S. Loh | O. O. Oaks |
| | C. J. Doughty | C. H. Quirk |
| LOO, PING YOK, Managing Director, China Engrg. Co., Nanking, China. | N. S. Loh | O. O. Oaks |
| | C. J. Doughty | C. H. Quirk |
| LUTY, DONALD J., Experimental Engr., Wood Hydraulic H. & B. Co., Detroit, Mich. | F. R. Bishop | J. D. Cantwell |
| | J. H. Walker | W. F. Arnoldy |
| MARINO, DOMINIC A., Student, New York University, New York, N. Y. | A. Raffes | P. Barbieri |
| | H. Maiman | A. Giannini |
| MCCORMACK, DENIS, Mgr., Air Cond. Dept., Julien P. Friez & Sons, Inc., Baltimore, Md. | D. J. Stewart | E. A. Jones |
| | Tom Brown | H. S. Bogaty |
| OBERG, H. C., Mgr., Engrg. Dept., Crane Co., St. Paul, Minn. | N. D. Adams | C. E. Gausman |
| | E. F. Jones | H. E. Gerrish |
| SCHMUTZ, JEAN, 40 Rue Amelot, Paris, France. | Robert Mautsch | |
| | Auguste Beaurrienne | |
| SMITH, J. DARRELL, Mech. Engrg. Dept., Philadelphia & Reading Coal & Iron Co., Pottsville, Pa. | H. E. Smith (*A. I. E. E.*) | A. V. Pickard (*Non-Member*) |
| | J. T. Foulds (*Non-Member*) | P. W. Harner (*Non-Member*) |
| SMYERS, EDWARD C., Sales Engr., Minneapolis-Honeywell Regulator Co., Pittsburgh, Pa. | T. F. Campbell | F. C. Houghten |
| | E. C. Evans | G. S. McEllroy |
| TOONDER, CLARENCE L., Air Cond. Engr., Kelvinator Corp., Detroit, Mich. | J. N. Hadjisky | E. H. Clark |
| | G. D. Winans | H. E. Paetz |
| WAUNG, TSING FI, Htg. Engr., Andersen, Meyer & Co., Shanghai, China. | N. S. Loh | O. O. Oaks |
| | C. J. Doughty | C. H. Quirk |
| WILSON, HAROLD A., JR., Student Salesman, American Radiator Co., New York, N. Y. | M. C. Barnum | R. D. Tyler |
| | O. O. Oaks | F. B. Howell |

## Candidates Elected

In past issues of the JOURNAL of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Membership Committee and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by Art. II, Sec. VIII, of the By-Laws, the following list of candidates elected:

### MEMBERS

GINI, ALDO, Engr., Via Corregio 18, Milan, Italy.

MONTGOMERY, ORA C., Asst. Supt. of Power, N. Y. Central R. R., New York, N. Y.

SEVERNS, WILLIAM H., Prof. of Mech. Engrg., University of Illinois, Urbana, Ill.

TORR, THOMAS W., Chief Engr., Rudy Furnace Co., Dowagiac, Mich.

YEAGER, GEORGE F., Inspector, Test Dept., Penn. R. R., Altoona, Pa.

### ASSOCIATES

BULLOCK, HOWARD H., Commercial Engr., General Electric Co., Los Angeles, Calif.

HARTMAN, F. S., Dist. Mgr., Ind. Dept., General Electric Co., New York, N. Y.

LEGLER, FREDERICK W., Mgr., Mpls. Retail Branch, Waterman-Waterbury Co., Minneapolis, Minn.

PRICE, CHARLES E., Editor, *Heating, Piping and Air Conditioning*, Chicago, Ill.

### JUNIOR

REINKE, ALFRED G., Instrument Maker, Westinghouse Elec. & Mfg. Co., Newark, N. J.

SCOTT, WILLIAM P., JR., Htg. Estimator, Scott Co., San Francisco, Calif.

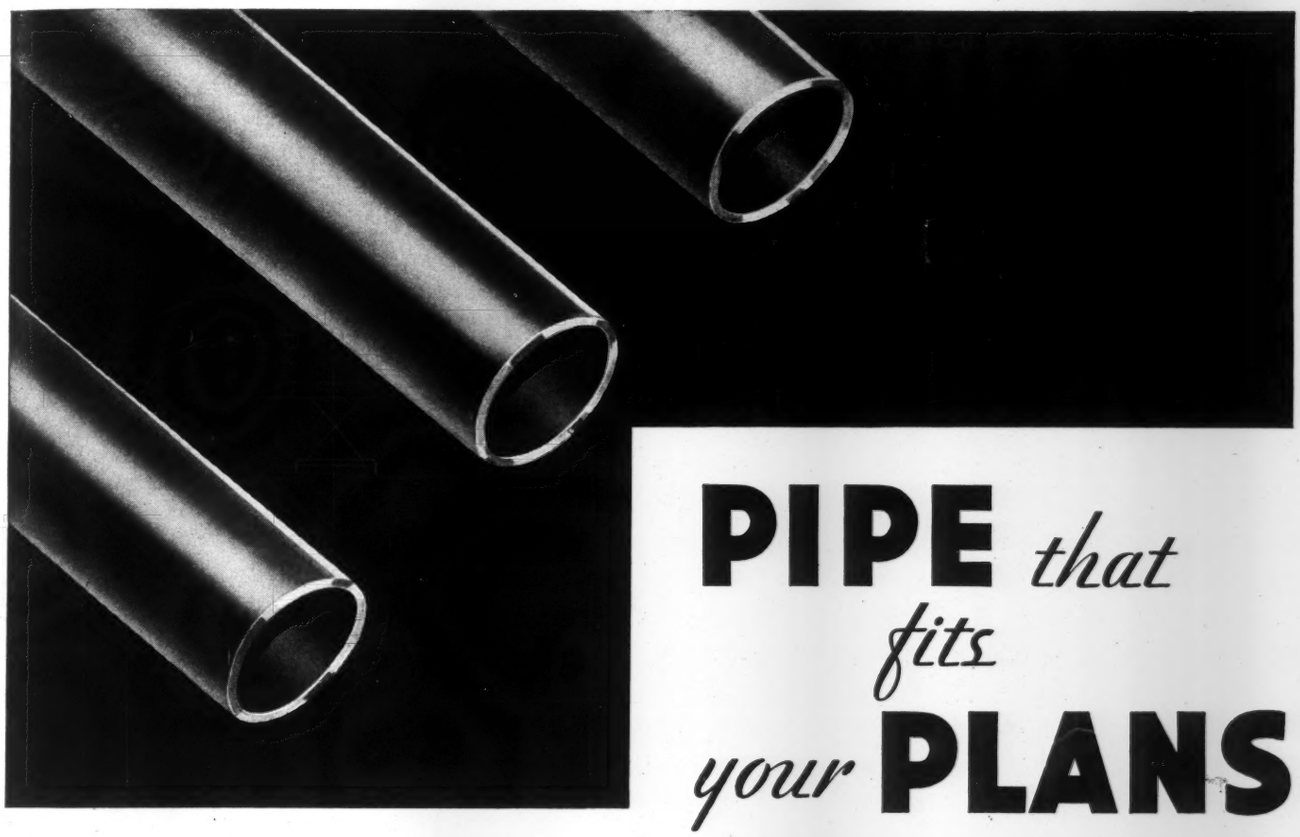
### STUDENTS

HALLAS, ROBERT S., Student, Case School of Applied Science, Cleveland, Ohio.

KARTORIE, V. T., Student, Case School of Applied Science, Cleveland, Ohio.

QUINLIVAN, LAURENCE P., Student, Case School of Applied Science, Cleveland, Ohio.

RAMSEY, RAYMOND F., Student, Case School of Applied Science, Cleveland, Ohio.



# PIPE *that fits your* PLANS

Whatever the anticipated pressures and temperatures that it may be called upon to withstand, NATIONAL Seamless Pipe can be depended upon to fit your plans. Uniform strength and adaptability to fabrication are outstanding advantages of this modern product of the largest manufacturer of tubular goods in the world. Being seamless—no welds—there is no line of possible weakness in it, lengthwise nor in any direction, for each length has been pierced from a billet of solid steel.

NATIONAL Seamless is workable and accommodating where bends have to be made and can be readily used with any kind of joint; flanged without injury, welded with ease. Power plant designers and engineers, in using NATIONAL Seamless Pipe, find altogether new measures of adaptability, satisfaction, and safety. Whatever your plans, this pipe will fit them. When specifying seamless, insist upon NATIONAL—

***America's Preferred Seamless Pipe***

NATIONAL TUBE COMPANY · Pittsburgh, Pa.
Subsidiary of United States Steel Corporation

WALLS WITHOUT WELDS
**NATIONAL SEAMLESS PIPE**
STRONG · SAFE · UNIFORM

CHECK THESE ADVANTAGES

- ✓ *Seamless—no welds.*
- ✓ *High tensile strength.*
- ✓ *Exceptional uniformity.*
- ✓ *Unusual ductility.*
- ✓ *Resistant to corrosive influences.*
- ✓ *Made from superior quality Open Hearth steel.*
- ✓ *Complete range of sizes, wall-thicknesses and lengths.*
- ✓ *Readily adaptable to any type of joint.*
- ✓ *Proved performance under exacting service.*
- ✓ *A product of the largest manufacturer of Seamless Pipe.*

# NATIONAL SEAMLESS

*PIERCED FROM SOLID BILLETS - NO WELDS*

# Another PROOF

## ..that the DUO-STAT DOES save steam

**Could any evidence be more conclusive than that presented in the graph above? By plotting the steam consumption against the average temperature *before* the Duo-Stat was installed and *after* it was installed, you can see at a glance just what savings were made.**

**This chart, showing Duo-Stat performance in the Madison-La Salle Building, Chicago, is merely typical of many similar charts which form a great mass of evidence for the Raymond Duo-Stat. More important than the individual records is the *consistent* saving that they show — savings that enables us to predict what Duo-Stat control can accomplish for you with ever-increasing accuracy.**

**Ask for a set of these interesting charts—or, better still, tell us your steam or fuel consumption by months for the last year so that we can prepare an accurate picture of your future steam costs with and without Duo-Stat.**

**F. I. RAYMOND CO.**
*629 W. Washington Blvd.*
**CHICAGO**

*The* DUO-STAT *alone combines these features*

- Controls room temperature by a combination of outside and radiator temperature. (A fully protected principle.)
- Is just as effective with one-pipe system as two-pipe system.
- Accomplishes partial filling of radiators in either a one-pipe or two-pipe system.
- Cannot be upset by open windows.
- Gives a modulated control that can only be described as Duo-Stat modulation.

**RAYMOND DUO-STAT**


# Equipment—

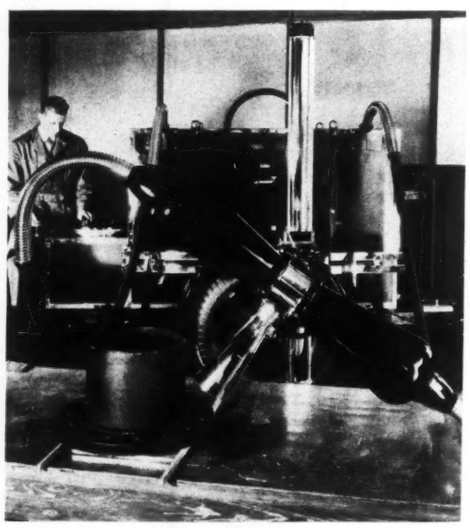
(*Continued from page 420, Editorial Section*)

Two air conditioners using remotely-located mechanical refrigeration or circulating ice water which cool, dehumidify and circulate air in summer and heat, humidify, and clean air in winter have also been announced. Air delivery is 400 cfm, capacity 12,000 Btu per hr.

## X-Ray Inspection Apparatus

Complete portable X-ray equipment is being introduced in the United States by the Industrial X-Ray Corporation, 665 Chamber of Commerce Bldg., Los Angeles, Calif., following the completion of arrangements between this concern and the N. V. Philips Corporation of Eindhoven, Holland. The equipment is available in three sizes.

The largest size is mounted on a two-wheel trailer for ease in transportation; it also may be handled conveniently by an overhead crane. Like the smaller sizes, it may be connected direct to a 220 v a-c outlet or to a 440-v power main. The



apparatus itself consists of three components: the high-voltage generator, in a metal container; the control box incorporating the necessary switches, regulating, and measuring controls; two shock-proof, high-voltage cables which connect the transformer to the ray- and shock-proof tube.

It is said that with 180 kv and 4 ma the following materials may be examined: iron up to 3½ in. thick (with special apparatus, up to 4 in.); copper, bronze, and brass to 2½ in.; aluminum to 10 in.

## Cast-Iron Convectors Announced

A new convector, consisting of a unit assembled of cast-iron finned sections and headers united with malleable nipples, has been announced by the American Radiator Company, 40 W. 40th St., New York City. It is adaptable to steam, vapor, or hot water systems and may be installed in an enclosure to provide a unit of high efficiency and attractive appearance.

Four widths (3¾, 5⅝, 7⅝ and 9½ in.) are available in a 13-in. length and lengths varying in 2½-in. steps from 18 to 60½ in. Tappings in the headers give a wide choice of piping connections to simplify installation and frequently to eliminate costly piping arrangements.

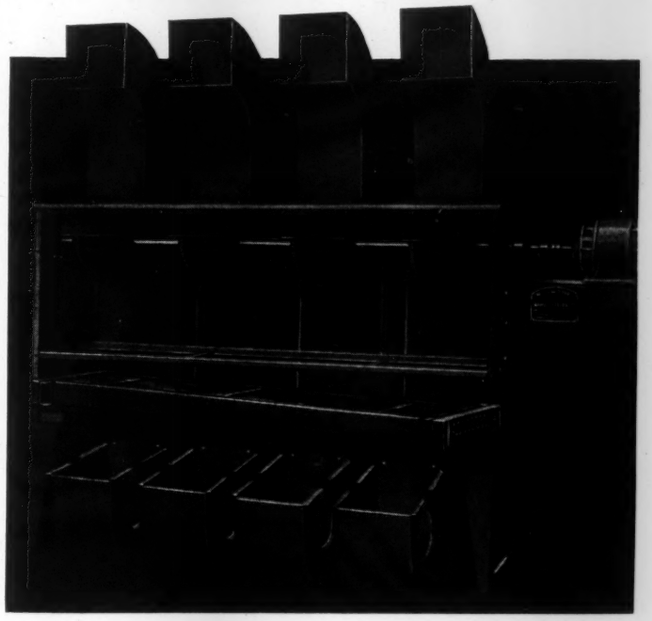
The fins are cast integrally with the cored section and are

## THE LOGICAL ANSWER TO INDUSTRIAL HEATING PROBLEMS

FROM this complete line of Clarage Unitherm Unit Heaters can be selected equipment to meet practically any requirement—one small unit to heat a cold corner or single room—a battery of larger units to care for an entire factory. Units can be furnished for floor mounting or ceiling suspension as desired.

Clarage Unitherms offer greater B.t.u. capacity—equipped with positive, centrifugal fans having self-limiting horsepower characteristic—compact—easy to install—not high priced. You'll effect substantial savings.

Write today for complete information, or for recommendation covering your needs. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

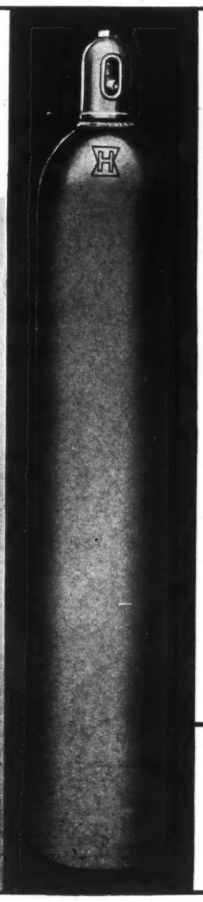


INTERNAL VIEW OF UNITHERM HEATER. With front sheet and fan housings removed, every part is readily accessible. Heating coil, highly efficient, light weight, non-corrosive and good for steam pressures up to 200 pounds, is removable through front of unit. Entire fan assembly mounted on ball bearings.

# CLARAGE

UNITHERM UNIT HEATERS

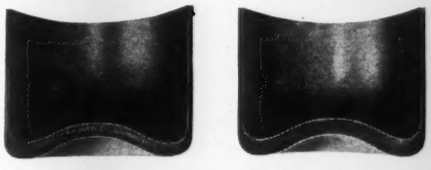
FROM MOLTEN METAL TO FINISHED PRODUCT



# HARRISBURG CYLINDERS ARE PLATE-MADE

IN the few words above you get one of the big reasons why Harrisburg is America's biggest maker of seamless steel cylinders for the transportation of gases under high pressures. "Plate-made" means maximum uniformity of side walls and bottoms. Harrisburg cylinders are also made from our own select steel and processed by specially designed machinery.

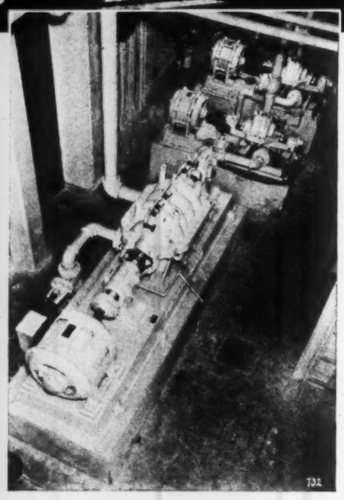
■■■



Left, ordinary cylinder. Right, Harrisburg cylinder, showing the greater uniformity of grain and wall thickness of Harrisburg plate-made cylinders.

## HARRISBURG PIPE & PIPE BENDING CO., Harrisburg, Pa.

CHARLES L. GULICK, New York City
JOSEPH A. JANNEY, JR., Philadelphia
THE CORBETT CORP., Houston
A. W. V. JOHNSON, San Francisco



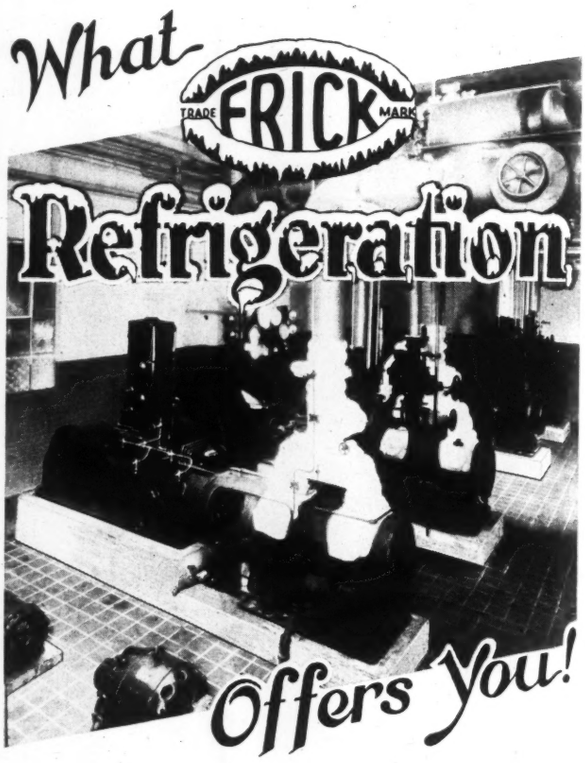
SHOWN above is the Los Angeles City Hall where American-Marsh Multistage Centrifugal Pumps, as shown at right, are used for delivering water from the city mains to the roof tanks.

Since installation these pumps have given perfect satisfaction, requiring no special attention whatever. Even the tragic earthquake of last spring, which destroyed millions in property throughout Southern California, failed to damage this pump installation in any way. Not for an instant was pump service interrupted by the disaster.

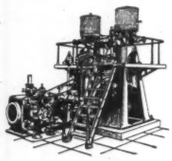
No matter how severe your operating conditions, you can count on American-Marsh Pumps. They are backed by sound engineering, built to precision standards, conservatively rated, and carefully tested.

And from our complete line of centrifugal and steam pumps can be chosen a unit to meet practically any requirement, large or small. Write for Bulletins to-day. AMERICAN STEAM PUMP COMPANY, Battle Creek, Michigan.

**AMERICAN-MARSH**
**PUMPS**
CENTRIFUGAL AND STEAM



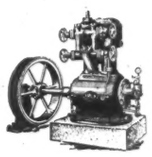

## Experienced Engineering



Beginning in the early 80's, Frick Engineers pioneered with the Corliss engine driven compressors which remained the standard for the Refrigerating Industry for 35 years.

## Up-to-the-Minute Equipment

Today, Frick Refrigerating Machinery offers you the last word in smooth, dependable operation, accurate control of temperatures, low horsepower required, attractive appearance, and overall satisfaction.



### Data and Estimates

Including surveys of existing or proposed refrigerating systems are supplied without obligation to all interested parties. Discuss your cooling problems with a Frick Engineer now: Write

**Frick Company**
WAYNESBORO, PA. U.S.A.
ICE MACHINERY SUPERIOR SINCE 1882

spaced to promote a steady and continuous flow of heated air throughout the entire surface. The large steam chamber in the cast-iron finned sections provides ample storage capacity for steam or hot water and insures a long "carry over" output, especially with automatically controlled heating apparatus, according to the manufacturer.

Detailed information, ratings, illustrations of enclosures, etc., are given in a bulletin which has been issued.

## New Capacitor Motors Announced

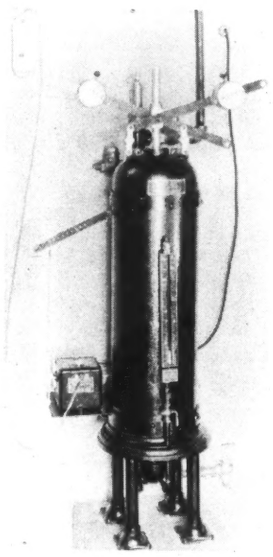
The Emerson Electric Mfg. Company, 2018 Washington Ave., St. Louis, Mo., recently announced a new line of high-torque, capacitor motors. These motors give an overload capacity in excess of 100 per cent; because of this and because of their cool-running design, they are especially desirable in the operation of compression equipment, certain types of oil burners, pumps, etc., according to the maker.

Air-gap tolerances and other precision refinements are close to aid in the reduction of electrical as well as mechanical noises. Patented resilient spring and rubber base mountings are employed to help materially in absorbing vibratory noises. Large oil reservoirs, with a wool-packed bearing assembly, give freedom from frequent relubrication.

Direction of rotation is clockwise, but is easily reversible. Frames are interchangeable for a-c and d-c. Flush bosses on cover permit mounting motors to blower housing. The condenser and outlet box is ordinarily mounted on top of the motor for compactness. It can be supplied this way or separately, as desired. The motors are available in sizes of ⅛ to ⅓ hp with resilient mountings; ⅛ to ⅓ hp with rigid mountings. These motors are designed to avoid radio interference during the operating periods.

## Controls Steam Pressures in Ounces

A regulator for controlling steam pressures in ounces and adaptable to the control of heating systems in industrial plants, college and institutional buildings, etc., has recently been announced by The Merrill Company, Inc., 98 Granite St., Boston, Mass. It operates on a balanced-scale principle, the pressure being controlled in the same manner as by a gasometer in a gas plant and indicated on a mercury gage. The control cylinder floats in a mercury seal. By adjusting the weights on the arms shown in the illustration the pressure can be varied over a range of one ounce to 3 pounds (5 lb on special order).



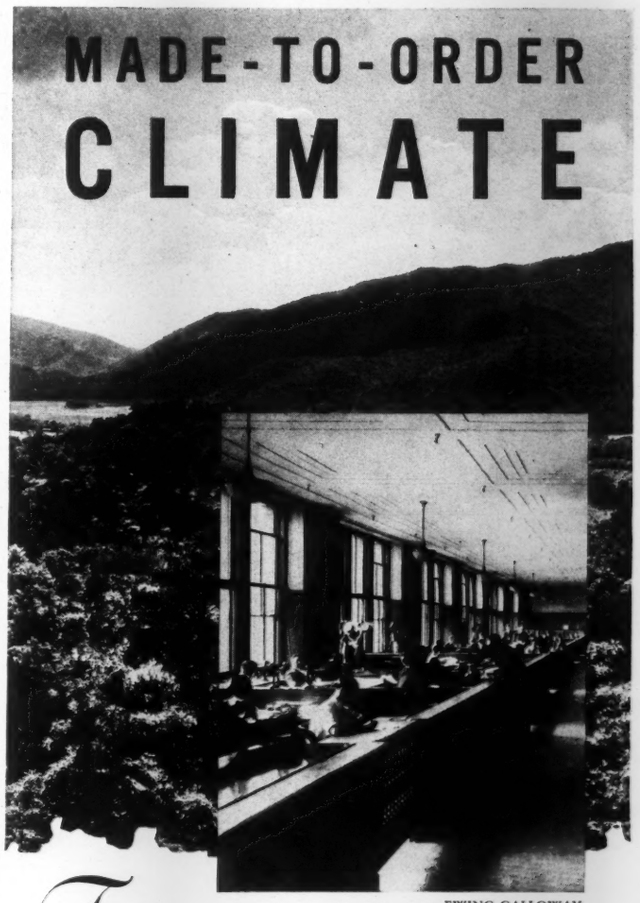
The regulator will control the lever on a pressure-reducing valve, the dampers on coal-fired boilers, the supply valve on gas or oil burners, etc. It operates cold with about a cupful of condensation per hour, according to the maker.

Weight of the device is about 175 pounds. The height is 46 in., diameter 11 in., and the distance across the levers when extended 24 in.

## V-Belts Improved

A new and improved type of Goodyear V-belt is announced by Worthington Pump and Machinery Corporation, Harrison,


MADE-TO-ORDER CLIMATE



EWING GALLOWAY

*For single room or entire building*

**Skyscraper or barbershop . . . railroad train or restaurant . . . office or department store . . . factory or home. For every kind and size of place there is Sturtevant Air Conditioning Equipment . . . exactly suited for the purpose.**

**In the comprehensive Sturtevant Line there are units for individual rooms and applications as well as apparatus for complete central systems . . . all up-to-the-minute in design and construction, and incorporating the fine engineering for which Sturtevant long has been famed in the field of air conditioning.**

**Let us put our 20 years of air conditioning experience at your disposal. At your request a Sturtevant Engineer will gladly visit your office . . . to supply full information and to cooperate in any way possible.**

**Sturtevant Cooling and Air Conditioning Corp., a division of B. F. Sturtevant Co., is organized for engineering and installing complete systems in both the Comfort and Industrial fields.**

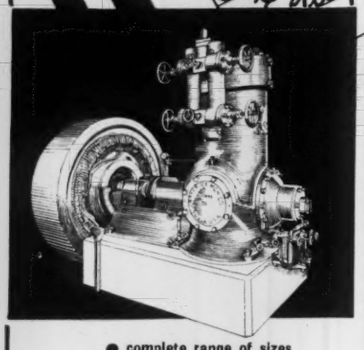
**B. F. STURTEVANT CO.**

**HYDE PARK · BOSTON, MASSACHUSETTS**

***Specialists in complete air conditioning with refrigeration since 1912***

ALWAYS SPECIFY

SPECIFICATION SHEET No. 1
Baker Compressor & L Air conditioning Equipment



BAKER refrigeration

Engineers everywhere know it's safe to *specify* Baker refrigeration . . . because there's a Baker Compressor to fit every job, large or small . . . and because they can rely on the 28 year Baker record for doing the job right!

- complete range of sizes
- advanced design
- factory co-operation
- prompt shipments

BAKER

ICE MACHINE COMPANY, Inc.
1590 EVANS ST., OMAHA, NEB.
Factories: Omaha, Ft. Worth, Los Angeles, Seattle

Obtainable through your supply house

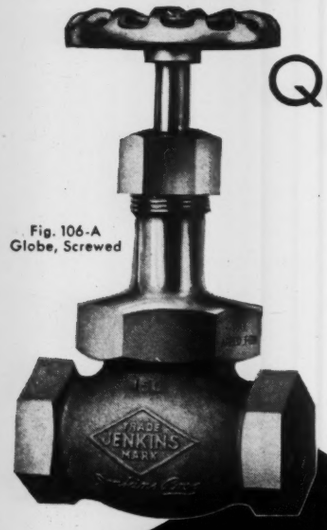


Fig. 106-A Globe, Screwed

Quality pays even today

There is QUALITY in Fig. 106-A Jenkins Bronze Globe Valve ...extra deep stuffing box...slip-on stay-on disc holder...one-piece screw-over bonnet...Jenkins Disc.

JENKINS BROS.
80 White St., New York, N.Y.
Bridgeport, Conn., Boston, Mass.
Chicago, Ill., Philadelphia, Pa.

Jenkins
BRONZE IRON STEEL
VALVES
Since 1864

Always marked with the "Diamond"

N. J., in connection with the Worthington multi-V-drive. Goodyear belts have been standard on this drive since its introduction.

High power capacity, long flexing life, uniform cross-section and low stretch are the primary factors considered in designing the new belt, says the announcement. A basic feature is a greater concentration, about the neutral axis of the belt, of the load-carrying capacity. There are two variations of the new construction. Nos. 0, 1 and 2 sizes have one endless cord in one plane, and Nos. 3 and 4 sizes have two endless cords in two planes. All cords are completely embedded in rubber to afford full insulation for the control of internal heat.

The tension and compression sections of the belt are composed of rubber, with layers of fabric distributed through the compression section to prevent excessive flexibility.

The belt is molded to shape, and is completely enclosed in a fabric envelope which protects the working elements and provides a contact surface for the V-grooved sheave. The fabric for the envelope is so cut that the threads run on the bias to prevent the envelope from taking any part of the load and protecting it from rupture. The envelope is "flipped" on the belt (not spiraled) and is so placed that the edges overlap on the top or bottom of the belt (not on the sides) to produce a smooth, unbroken surface on the contact faces.

## Unit Coolers Have Inclined Element

A complete line of electrically refrigerated force-draft unit coolers for commercial refrigeration applications has been announced by The Fedders Manufacturing Company, Buffalo, N. Y. They combine convection and forced-draft circulation to prevent stratification and pocketing of the air and to maintain uniform temperature from floor to ceiling.

The cooling element is inclined at an angle in the housing. The angle of the fins and tubes directs the air stream upward toward the ceiling and it then drops and diffuses. The inclined element eliminates the necessity for louvers or shutters. Condensation automatically drains from the rear of the fins.

Continuous seamless copper tubes are used with no headers or joints necessary. Copper fins are bonded to copper tubes to give metal-to-metal contact to promote heat-transfer efficiency.

Automatic temperature control is provided by a thermostatic expansion valve located on the rear of the cooler where it can be easily adjusted for any desired temperature. Its use makes possible the installation of the unit's coolers on multiple installations.

This company has also recently announced all-copper, continuous-tube condensers for commercial refrigeration and non-frost commercial evaporators. New bulletins on all three developments are available.

## Oil Fired Water Heater is Compact

The new oil-fired commercial water heater made by the Wood Hydraulic Hoist and Body Company, Detroit, Mich., is designed to fill the hot-water requirements of stores, apartments, laundries, schools and factories. It heats 200 gph of water through a 100-F temperature rise, and if greater volume is required, two or more units can be coupled together.

The burner operates on No. 3 fuel oil and is equipped with electric ignition and operating controls. The firebox is insulated and lined with refractory material, so that the heat on the side walls is radiated back into the flame to raise the temperature and increase combustion efficiency.

The water heater itself provides a maximum amount of heating surface through the use of closely-set horizontal fire tubes. The fire tubes are grouped together in upper and lower banks, and the gas travel is double passed, first through the lower pass, then back through the upper pass to obtain a high percentage of heat absorption.

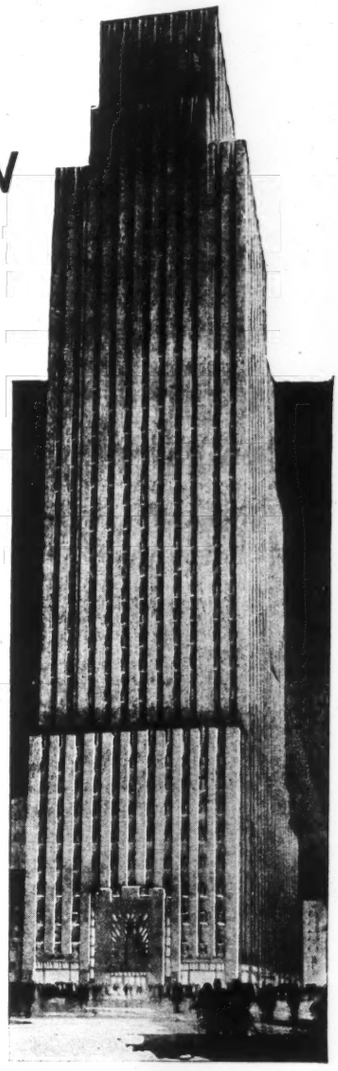
This new heater, similar in principle to large power boiler

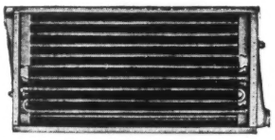
# AEROFIN

IS THE HEAT-SURFACE FOUND IN THE

## NEWS BUILDING

NEW YORK CITY





*The Standardized Light-Weight Fan System Heat-Surface*

**4 Types 196 Standard Sizes**

A comprehensive and helpful Bulletin will be mailed without charge upon request to Newark. Please use your business letterhead and ask for Bulletin 32.

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This is not happenstance. *AEROFIN* is selected by America's foremost Architects and Engineers because of its *proved* superiority. Pioneering light-weight, non-corrodible, *unit* Fan System Heat-Surface years in advance *AEROFIN*, designed and constantly improved by Fan Engineers, is still years in advance. Newark will be glad to send informative and appropriate publications upon request. Any Office will gladly render prompt, efficient, technical cooperation.

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# Add this organization to your own

# by using WAGNER MOTORS

When you design a motor-driven product and program the expenditure of time, effort and money to develop sales for that product, you naturally give consideration to the staying qualities of the manufacturer supplying the motor. Perhaps you investigate the manufacturer's financial condition. All of this is good business.

Past performance is about the only yard stick by which you can measure the staying qualities of any manufacturer.

Wagner offers its record of forty years' service to the electrical industry as evidence of its staying qualities. In those forty years Wagner has built a national reputation and acceptance of its products. Wagner offers to manufacturers and dealers of heating and ventilating machinery, the cooperation of a nationwide organization, 26 branch offices, service stations and motor warehouses.

*Illustrations:*
*The huge Wagner plant at St. Louis, and the location of Wagner's 26 branch offices.*

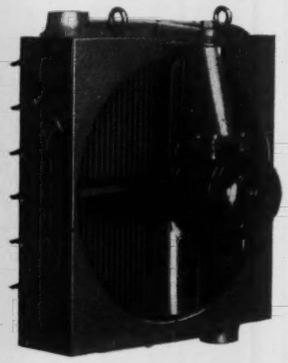
# Wagner Electric

6400 Plymouth Ave.
St. Louis, U. S. A.

MOTORS : TRANSFORMERS : FANS : BRAKES

M233-1H

Young Unit Heater



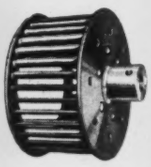
YOUNG

Unit Heaters—Blast Coils
Original Streamaire Copper Convection Heaters—Enclosures
Quality Built Patented Construction
Engineering Offices All Principal Cities

YOUNG RADIATOR CO.
HEATING DIVISION
Racine : Wisconsin

A New Metal Faced Insulation
for Heating, Cooling and Ventilating Systems

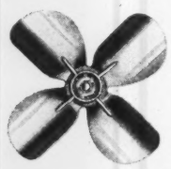
Ferroclad Structural Panels provide a rigid, permanent, firesafe, rodentproof insulation for heating and refrigerating ducts, fan rooms, heating units, radiator panels, etc. They consist of any type or thickness of insulation permanently sealed between metal plates.
Sample and catalog on request.
TRUSCON STEEL COMPANY, YOUNGSTOWN, OHIO
Ferroclad Structural Panels



TORRINGTON
FANS AND BLOWER WHEELS

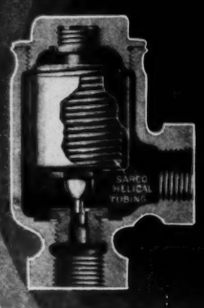
Patented All Aluminum Multiblade, Balanced Blower Wheels. Unexcelled for quiet and smooth operation.

30 years' experience building Propeller Fans, assembled, balanced and tested, ready to mount on motor shaft.



THE TORRINGTON MFG. CO.
44 FRANKLIN ST.
TORRINGTON, CONN.

SARCO
STEAM TRAP



Simply screw the Sarco Steam Trap into your pipe-line. It is self-adjusting for pressures from 0 to 100 lbs. That saves time. Saves work.

It drains all condensation as soon as formed. Doesn't leak — doesn't waste steam. Cannot air bind.

It costs about one-third the price of big bucket or float traps. Sold on 30 days' free trial. Booklet 0-95 on request.

SARCO CO., INC.
183 Madison Ave., New York City
*Branches in Principal Cities*

design, is compact and self-contained, with an overall height of 46½ in. It may be installed in a short time.

### Offers 5-in. Dial Thermometer

C. J. Tagliabue Mfg. Co., Park and Nostrand Ave., Brooklyn, N. Y., has announced a new 5-in. dial indicating thermometer in a black bakelite case. It has a powerful moving element or bellows suited to certain commonly-used vapor tension ranges between minus 40 and plus 335 F.

The indicating pointer is actuated by the motion of a bronze bellows which expand and contract at a slight temperature change at the bulb. This motion is transmitted directly to the pointer by a vibration-proof connecting mechanism.

Neat in appearance, the black bakelite case contrasts with the large white numerals of the black dial, promoting readability.

A special descriptive bulletin is available.

### New Solenoid Refrigerant Valves

Two new solenoid-type valves especially designed for control of methyl chloride, freon, and other refrigerants have been developed by the Automatic Products Company, Milwaukee, Wis. One model has a maximum operating pressure of 100 lb; the other, 200 lb. The latter has a power consumption of 10 watts; the former, 15 watts. The 200-lb type has a small pilot valve which, in opening, permits the pressure of the liquid to operate against a piston to open the main valve. The 100 lb type is a smaller unit having an impact-type plunger.

All metal parts are brass or rust-resisting steel.

## Recent Trade Literature

*Air Conditioning*: Campbell Metal Window Corporation, Park Ave. & 42nd St., New York City, 16-page booklet on the advantages of air conditioning and noise control in executive offices, addressed to executives and emphasizing the importance and methods of increasing efficiency by such means.

*Air Conditioning:* B. F. Sturtevant Company, Hyde Park, Boston, Mass. 20-p. catalog of unit equipment for heating, humidifying, ventilating, cooling, and dehumidifying in industrial and comfort air-conditioning applications, including railway cars.

*Boilers:* Kewanee Boiler Corporation, Kewanee, Ill., 36-page catalog of steel-riveted fire-box boilers, brick-set and portable types, up-draft and down-draft. Specifications, setting measurements, and details showing settings are given, features of construction are discussed.

*Boiler Controls and Cut-Offs:* McDonnell & Miller, Wrigley Bldg., Chicago, Ill., 4-page condensed catalog and price manual of automatic boiler-water-level controls and low-water cut-offs, with brief descriptions of the several types.

*Cast-Iron Pipe and Fittings:* The Central Foundry Company, 420 Lexington Ave., New York City, 56-page booklet featuring cast-iron pipe and fittings (2 to 30-in.) for industrial and municipal water supply and distribution, fire protection, sewage disposal, etc. May be had cement lined. Dual-lock joint pipe and fittings for industrial water supplies, gas distribution lines, oil field and refinery uses, air, hot gases and liquors, filtration plants, mine drainage, etc., are also covered.

*Circulators:* The Rochester Circulator Corporation, P. O. Box 23, Rochester, N. Y., 6-page folder describing circulators for hot-water heating systems, ice-water supply, brine circulation, and industrial and chemical circulation work. Consists of electrically-driven propeller unit direct-connected to motor for installation in a standard pipe tee or cross. Its application to new and old heating systems is discussed in detail.

*Combustion Control:* Morey & Jones Ltd., 922 S. Hemlock St., Los Angeles, Calif., 4 page bulletin describing a regulator for

combustion control, including features of construction, explanation of compensating principle, operation, and installation.

*Convectors:* Commodore Heaters Corp., 11 W. 42nd St., New York City, 8-page bulletin discussing convection heating, showing construction of convectors, and presenting tables of effective heating capacities. Various types of installations are illustrated and cabinets are shown.

*Grilles and Registers:* Uni-Flo Grille Corporation, 4646 Lawton Ave., Detroit, Mich., 16-page booklet on the trend in modern design of grilles and registers for air conditioning and concealed radiation, including a discussion of the factors in design, noise and its relation to grille design, dampers, testing air flow, etc. Drawings and photographs are presented showing typical designs.

*Motors:* Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., 12-page bulletin devoted to the features and applications of Thermoguard self protecting motors (induction, direct-current, synchronous) and presenting detailed information on a-c and d-c control.

*Motors:* General Electric Company, Schenectady, N. Y., 4-page technical bulletin on fractional-horsepower gear-motors, 1/6 to 3/4 hp, 500 to 11 rmp, single-phase, polyphase, or direct current.

*Motors:* Wagner Electric Corporation, 6370 Plymouth Ave., St. Louis, Mo., 6 page bulletin on long-hour-duty split-phase motors, including illustrations and descriptive material of the parts, their construction, and functions.

*Rules:* The Lufkin Rule Co., Saginaw, Mich. Circular showing new stainless-steel, pocket type 6-ft rule.

*Timers:* General Electric Company, Schenectady, N. Y. Data sheet describing telechron-motor-operated automatic timers for process timing, including information on applications, adaptability, operation, construction, ratings, etc.

*Unit Coolers:* Buffalo Forge Company, Buffalo, N. Y., 4-page bulletin describing and giving ratings and dimensions of suspended-type, floor, and flat suspended unit coolers; also a comfort conditioner which cools and heats.

*Vacuum-Heating Pumps:* Insley Engineering Corp., Indianapolis, Ind. Data sheet describing construction and operating features of liquid piston vacuum heating pumps for 5,000 to 100,000 sq ft of radiation, 0 to 27 in. vacuum.

## Conventions and Expositions

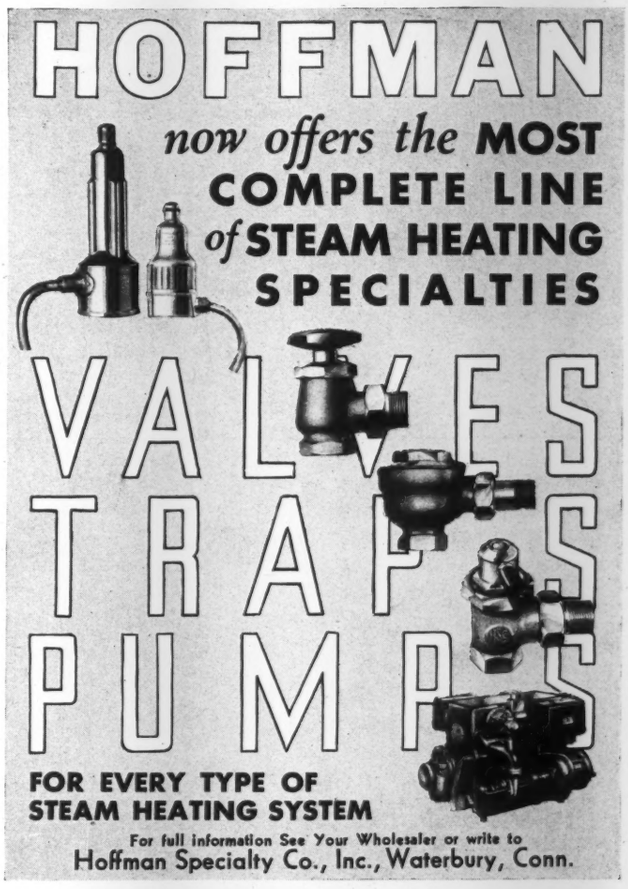
*American Gas Association:* Annual convention, September 25 29, Chicago. Headquarters Office, 420 Lexington Ave., New York City.

*American Society of Heating and Ventilating Engineers:* Annual meeting, February 5-8, New York City. Secretary, A. V. Hutchinson, 51 Madison Ave., New York City.

*International Heating and Ventilating Exposition:* Third exposition, February 5-9, 1933, Grand Central Palace, New York City. Charles F. Roth, Manager, International Exposition Co., Grand Central Palace, New York City.

## New Manual of English Helpful to Engineers

To the engineer who finds the organization and preparation of a technical article, paper or report a task, it would be difficult to recommend a more helpful aid than "The Engineer's Manual of English," by W. O. Sypherd, Professor of English at the University of Delaware, and Sharon Brown, Associate Professor of English at Brown University (Scott, Foresman and Company, 326 pages, $2.00). It was written to be a practical guide for the engineering student and for the professional engineer.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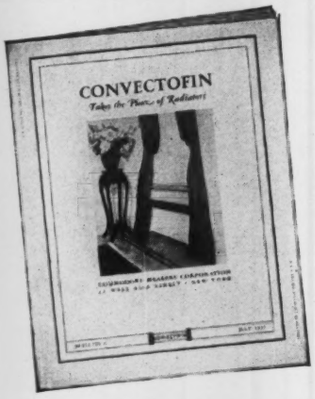


**Bulletin No. 6**

This treatise, just off the press, contains much new data on heating that has never before been published. The reason why the CONVECTOFIN method of heating is more efficient and more economical than the old-fashioned radiator is clearly illustrated. If you are interested in economical heating, ask for a copy. If you have a heating problem, tell us what it is. We will gladly advise and quote.

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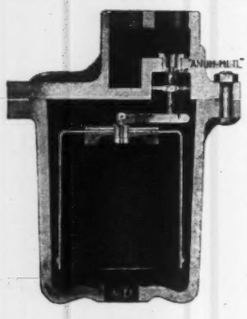

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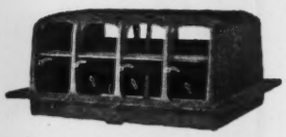

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Noteworthy is the illustrative material, which includes samples of many types of business correspondence and a complete collection of engineering writing. The text concentrates upon those phases of writing essential to the engineer and is most comprehensive.

The chapter headings include general problems; mechanical details; correspondence; report writing; and technical journals, bulletins, specifications, etc. Included in the specimens of engineering writing are periodic reports, progress reports, special information reports, examination reports with and without recommendations, editorials, summaries and abstracts, book reviews, technical articles, bulletins, booklets, and catalogs, and specifications. The appendices include information on preparation of manuscript and correcting proof, specifications for patents, writing theses, and a bibliography.

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## Galvanized Piping—

*(From page 413, Editorial Section)*

### What Happens When Galvanized Pipe Is Welded

It would be well at this point to review what actually happens on a pipe, galvanized, when either fusion welding or bronze-welding is applied. In considering the effect of welding on galvanizing, it must be assumed that welders of reasonably good ability, who realize that in general all welding should be done with the minimum amount of heat consistent with good fusion or adherence of the weld deposit, are being employed.

In applying neutral-flame fusion welding to galvanized pipe, using a steel welding rod, approximately the portion of the inside pipe wall marked *A* in the upper sketch (p. 413) will become very hot due to the direct application of the flame on the reduced thickness of the beveled ends. In this type of welding where considerable portions of the beveled ends would be melted and fused into the weld metal, it is safe to say that galvanizing is completely removed from the portion *A* on the inside of the pipe, as well as for a distance equal to or even greater than "½ *A*" beyond the limits of the weld on the outside of the pipe wall. More galvanizing is removed from the outside because of the more direct contact with the welding flame. On the inside beyond the width *A* galvanizing is gradually increased to the original thickness at such a point as *O* where the heat has not been intense enough to volatilize the zinc.

However, in making a bronze-weld, where the surfaces of bevels forming the vee are always well below the fusion temperature, the minimum intensity and duration of heat will have still less effect on the coating.

The distance *B* in the lower sketch approximately represents the width of a band around the inside of the pipe where the galvanizing will be at all affected. The effect will be negligible near the edges of this band with a gradual thinning of the galvanizing as the center of the weld is approached. For a short distance, perhaps ⅛ in. or 1/16 in., on each side of the center of the band the galvanizing may be completely removed from the abutting pipe ends. In many instances, however, a thin film of bronze spreads around the inside surface of the pipe much as solder will spread automatically on a properly-tinned surface when the heat is right.

This spread of bronze around the lower edge of the thin portions forming the vee protects the edges somewhat even though the galvanizing may be completely removed for a small distance back from the ends.

In bronze-welding, the lower heat joint and the character of the metal deposited combine to give maximum protection from corrosion. No instances are known of premature failure of galvanized piping due to early corrosion of the welded joints.

It may be concluded that experience indicates that corrosion of welded galvanized pipe need not be considered. It may be welded with either steel or bronze welding rods, the choice being principally a matter of economics and appearance.

## Tentative Draft for Welding Neck Flanges

A tentative draft of the proposed American Standard for Steel Welding Neck Flanges (B16el-) is being circulated by the *American Standards Association* for review and criticism. Sponsor organizations are the *Heating and Piping Contractors National Association, Manufacturers' Standardization Society of the Valve and Fittings Industry,* and *The American Society of Mechanical Engineers.* The standard is for maximum steam service pressures of 150 lb per sq in. (gage) at 500 F and 100 lb per sq in. at 750 F; 300 lb at 750 F; 400 lb at 750 F; 600 lb at 750 F; 900 lb at 750 F; and 1500 lb at 750 F.

C. P. Bliss is chairman of the sectional committee on standardization of pipe flanges and fittings and C. H. Haupt is chairman of the subgroup on welding flanges.

## Index to Business Reports is Issued

Key to a wealth of factual information on business methods will be found in the *Index of Economic Reports* recently issued by the policyholders service bureau of the Metropolitan Life Insurance Company. Listed in this publication are the titles of over 500 reports and articles on problems of management that have been published and made available for distribution by the bureau.

Practically the entire range of management is represented by the studies cataloged in the *Index.* Illustrative of the range of interest represented by the material listed in the booklet are the titles of a few representative reports. These include *The Manufacturing Expense Budget, Methods of Organizing and Conducting Industrial Safety Contests, Air Conditions and the Comfort of Workers, and Employe Suggestion Systems.*

The reports are the result of investigations conducted by the policyholders service bureau. A bird's-eye view of the bureau is given in the introduction to the *Index,* which states that its efforts are devoted to the cause of better management in business, and in the interest of the economic health or well-being of the insurance company's 26,000,000 policyholders.

Copies of the *Index* may be obtained by writing to the Policyholders Service Bureau, Metropolitan Life Insurance Company, One Madison Avenue, New York City.

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### MISCELLANEOUS

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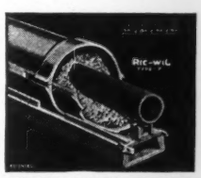
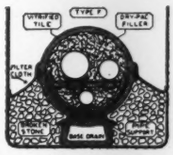
**Naugatuck Mfg. Co., Union City, Pa.**



Ric-wiL Tile Conduit, Type F, insulated with Dry-paC.



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